BERING-CHUKCHI SEA HERRING

FISHERY MANAGEMENT PLAN

Final

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NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
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Submitted to the Secretary of Commerce on November __, 1983 as the Council's recommendations for the management of the herring fishery in the Bering and Chukchi Seas.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 SUMMARY

The Magnuson Fishery Conservation and Management Act (Magnuson Act) established a Fishery Conservation Zone (FCZ) which extended U.S. jurisdiction to 200 miles beyond the coastline of the United States. The Magnuson Act also established eight Regional Fishery Management Councils to aid in the management of the fishery resources within this 200 mile zone. Each Regional Council is charged with preparing a Fishery Management Plan (FMP) for each fishery which is in need of management. The purpose of each FMP is to prevent overfishing, to provide for an optimum yield of the resource to the fishermen and to the nation, and to promote fair and equitable sharing of the resource in accordance with the National Standards set forth in Section 301(a) of the Magnuson Act.

The North Pacific Fishery Management Council (NPFMC or Council), with assistance from the Alaska Department of Fish & Game (ADF&G) and the National Marine Fisheries Service (NMFS), has developed this FMP for the herring resource of the Bering and Chukchi Seas.

This Bering/Chukchi Sea Herring FMP is intended to act as a framework for managing the fisheries in the FCZ on a multi-year basis. The FMP proposes to establish a cooperative management program in which efforts will be made to ensure that Federal offshore (FCZ) and State of Alaska inshore herring management regimes complement each other. Successful implementation and operation of this management plan requires the cooperation of the Council, NMFS, and the Alaska Board of Fisheries (Board).

The Bering/Chukchi Sea Herring FMP has evolved over a period of several years. During this period numerous changes have occurred in the domestic and foreign fisheries, the herring resource itself, and the scientific information available for management. Of the three, the available scientific information has changed the least although certain improvements have been made. Lack of adequate information on the abundance and distribution of the herring stocks has lead to uncertainty about the health of the resource and the impacts of fishing upon the resource. In response to this uncertainty, the management agencies involved have been and continue to be cautious and conservative in

their management policies. This FMP intends to continue this conservative approach and to foster optimum utilization of the resource within strictly conservative bounds.

The FMP recognizes the preference given to domestic inshore fisheries. These fisheries, both subsistence and commercial, are managed by the State of Alaska. The FMP protects these fisheries by severely limiting the amount of directed and incidental catch of herring by offshore fisheries. It eliminates directed herring fishing by foreign vessels, and it allows domestic offshore fishing only after the inshore fisheries have been completed, thus reducing competition for the limited resource.

1.1 The Fisheries

The subsistence fishery is conducted within territorial waters from the coast of the Alaska Peninsula to the southern part of the Chukchi Sea, with varying degrees of local dependency on the resource. This is a small spring and summer gillnet fishery (average annual catch from 1975-1980 was approximately 100 metric tons) for herring for personal use.

The domestic commercial herring fishery includes a spawn-on-kelp fishery (1982 harvest was 141 mt worth $234,000) and a herring sac roe fishery (1982 harvest was 24,900 mt worth $7.6 million). Both fisheries are conducted in a short late spring and early summer season, generally by off-season salmon seiners and gillnetters, within territorial waters. There is also a growing bait and food fishery (in 1982, 3,200 mt worth $1.1 million).

Japan and the U.S.S.R. were the historic participants in the directed distant water herring fishery conducted primarily northwest of the Pribilof Islands. Catches declined after the peak in the late 1960's and early 1970's (Japanese catch in 1968-1969 was 50,857 mt, Soviet catch in 1969-1970 was 92,228 mt, foreign fleet total in 1968-1969 was 128,230 mt). A Preliminary Fishery Management Plan (PMP) for trawl fisheries and herring gillnet fisheries in the Bering Sea and Aleutian Islands was implemented in 1977, substantially ending the foreign directed food and bait herring fishery, and limiting foreign vessels to an incidental harvest of herring in groundfish trawl fisheries.

Since a court order was issued in February, 1980, herring has been a prohibited species, i.e. the taking of herring must be avoided and any herring caught by the foreign fishery must be thrown back and not retained. This order also terminated plans of United States fishermen for pioneering joint venture operations with Soviet processing vessels for 1980.

Under this FMP, domestic herring fishing and joint venture operations for herring would be allowed under certain circumstances, but directed foreign fishing for herring is prohibited. Herring harvested incidentally by foreign vessels may not be retained.

The Fishery Management Plan for Bering/Chukchi Sea Herring utilizes the best available biological and historical information on the herring resource and herring fishing industry and proposes the following:

1.2 Management Objectives

The Council has determined that the priorities for fisheries which utilize the herring stocks which are covered by this plan are as follows:

(1) subsistence fishery
(2) inshore commercial fisheries
(3) offshore domestic fisheries

Based upon these priorities, the following specific objectives have been developed.

(1) To conduct any harvest of herring in the FCZ in such a manner to insure:

   (a) Maintenance of the herring resource at a spawning level that will provide the maximum production of recruits.
   (b) Maintenance of the subsistence herring stocks and the subsistence fishery.
   (c) Maintenance of the herring resource at a level that will sustain populations of predatory fish, birds and mammals.

(d) Development and maintenance of the inshore commercial fisheries.

(2) Consistent with objective 1, promote full utilization of the herring resources by domestic offshore fisheries.

(3) Provide to the extent possible a unified management regime between federal and state jurisdictions.

It is recognized that the preferences among inshore fisheries are determined and implemented by the State of Alaska. The offshore fisheries will be managed to reduce their impact on the inshore fisheries.

1.3 Annual Determination of Yield

The Maximum Sustainable Yield (MSY) is a measure of the average maximum annual yield of the fishery over a long period of time. The method chosen for the calculation of MSY uses the total annual herring harvests for the period 1962-1976, excluding 1967 due to lack of data. MSY is set at 48,712 metric tons (mt) which is the equivalent of a 20% harvest of the total MSY biomass of 243,560 mt. This estimate may be revised as additional research and catch information become available.

Herring populations are subject to rapid fluctuations in abundance over relatively short time periods. The acceptable biological catch (ABC) in any given year must reflect current stock conditions to the maximum extent possible. Therefore, ABC shall be determined annually and may be adjusted during the year as new information becomes available. The ABC determined under this plan applies to the combined state and federal management areas.

The annual estimate of the ABC will be calculated by the formula

$$\text{ABC} = \text{annual exploitation rate} \times \text{spawning biomass estimate}$$

$$= \left[\frac{\text{spawning biomass estimate}}{\text{MSY biomass}} \times 0.2\right] \times \text{spawning biomass estimate}$$

The maximum exploitation rate allowed by this FMP is 20%.

The best available estimate of biomass will be used in determining ABC each year. It is expected that the primary basis for these annual estimates will be counts of herring schools made during aerial surveys conducted by ADF&G throughout the spawning season. Estimates are not available for the Aleutian/ Alaska Peninsula stock grouping or the Port Clarence/Kotzebue Sound stock grouping. When spawning biomass estimates are available they will be included in the spawning biomass estimation used to determine ABC.

The spawning biomass estimate for the stock spawning at Nelson Island is not included in the biomass estimate used in determining the exploitation rate and ABC. Exemption of this biomass prevents an unwarranted increase in the exploitation of other stocks which would occur without this modification to the procedure.

In the absence of adequate aerial survey data the primary stock assessment tool will be virtual population analysis (VPA or cohort analysis).

If it is not possible to determine herring abundance by using aerial surveys or VPA, stock condition will be assessed by using commercial catch rates, the percentage of roe recovery, ratios of pre to post spawners from test net and commercial catches (both inshore and offshore), spawn deposition observations and any other available information. When virtual population analysis or other methods are used to provide biomass estimates, those estimates must be reduced to a spawning biomass estimate before they may be used to determine ABC.

An Allowable Incidental Catch (AIC) and a Prohibited Species Catch (PSC) will be established annually for the domestic and foreign groundfish trawl fisheries, respectively. AIC, which can be retained, is part of the herring optimum yield (OY). PSC, which cannot be retained, must be reported but will not be considered part of an OY. AIC and PSC are both calculated by applying an incidental catch rate to a nation's groundfish allocation and are designated on a herring fishing year basis. The guidelines for the determination of AIC and PSC are specified in Section 8.3

The Optimum Yield (OY) is that portion of the ABC which is made available for directed harvest in the FCZ. OY is the sum of three components: AIC, a summer apportionment, and a winter apportionment. AIC is equal to the U.S. groundfish allocation times 0.10%, and is available throughout the year and throughout the management unit where no other herring apportionment is available.

The summer apportionment of OY is 2,000 mt and is available for harvest in the Alaska Peninsula/Aleutian Islands area south of 55°47'N latitude during the period July 1 through September 30. When 2,000 mt has been harvested in the combined state and federal waters, the FCZ will be closed to fishing for herring until the next apportionment is made. The Regional Director has the authority to adjust this apportionment and season both before and during the season.

The winter apportionment of OY, if any, may be harvested throughout the management unit from October 1 until March 31, which is the end of the fishing year. The winter apportionment of OY for the management unit will be calculated annually by the following formula

$$\text{Winter Apportionment of OY} = \text{ABC} - \text{Inshore Commercial Harvest} - \text{subsistence adjustment} - (\text{AIC} + \text{PSC})$$

In the event that the winter apportionment of OY as calculated is less than zero, the winter apportionment of OY shall be set equal to zero.

The winter apportionment of OY is further reduced by 50%. This reduction of the winter apportionment of OY is due to the social and economic importance of the subsistence and inshore commercial fisheries. The reduction insures that the winter apportionmnent of OY will remain conservative to protect these priority fisheries. The Council will review this procedure for determining the winter apportionment of OY within three years after the implementation of this plan.

This apportionment shall be further limited as follows.

(a) If the amount so calculated is less than 2,000 mt, the winter apportionment of OY shall be zero. This limitation is to insure that any winter apportionment of OY will be large enough to insure that a directed herring fishery is undertaken, not just an increase of the incidental harvest in the groundfish fishery.

(b) If the current herring spawning biomass is less than one-half of the MSY biomass, the winter apportionment of OY shall be zero. This limitation is to insure that at times of low spawning biomass rebuilding of stocks is placed in higher priority than the offshore fishery.

(c) If the amount so calculated is greater than 10,000 mt, then the winter apportionment of OY shall be 10,000 mt. This limitation is to insure that any offshore fishing which is authorized is controlled in its development. The Council does not feel in light of the priorities for other fisheries established in this plan and the status of the resource that a winter apportionment of OY will be available in every year, and therefore the Council does not wish to encourage an offshore fishery to develop which is dependent upon this allocation.

The winter apportionment of OY as calculated may be further reduced by the Regional Director or the Council, in consultation with the State, if either finds a serious problem resulting from any of the following factors.

(a) Extent to which the subsistence and inshore commercial fisheries harvested or overharvested the ABC.

(b) Condition of the spawning stocks of herring with special focus on the subsistence stocks.

(c) Abundance of spawning herring and their spawning success.

(d) Age composition of the spawning herring.

(e) Recruitment to the spawning stocks of herring.

(f) Variation in exploitation rates between the spawning stocks.

Annually by July 1, ABC shall be estimated by the Regional Director of NMFS according to the ABC formula. The Council and its advisory groups shall review this estimate, and the Council shall then provide for public comment on the estimate and procedures.

The Council shall by October 1 recommend a final value of ABC and the winter apportionment of OY to the Assistant Administrator or the Alaska Regional Director, NMFS, who will specify the final value for the current fishing year.

1.4 Allocations to the Fisheries

1.4.1 Fishing year. April 1 to March 31

A fishing year commencing April 1 coincides with the migration of herring into coastal waters for spawning and is a natural division between the fisheries occurring on the winter grounds and those on the spawning grounds.

1.4.2 Allowable Incidental Catch (AIC) apportionment of OY

AIC shall be apportioned to the U.S. groundfish fishery each herring fishing year. AIC shall be equal to 0.10% of the U.S. groundfish DAH as determined throughout the FMP for Groundfish in the Bering Sea/Aleutian Islands Area. AIC is available throughout the management unit and throughout the year where no directed apportionment of herring OY is available (see Sections 8.3 and 10.1).

1.4.3 Summer (Aleutian Islands/Alaska Peninsula) apportionment of OY

Two thousand mt of herring is apportioned to the offshore summer food or bait fishery of the Aleutian Islands/Alaska Peninsula area. This apportionment shall be harvested only south of 55°47'N latitude, during the period July 1 through September 30 (see Section 10.2).

1.4.4 Winter apportionment of OY

The ABC and winter apportionment of OY values shall be calculated according to the provisions of Section 7.6.2.3 and Section 10.3. The winter apportionment is limited to 10,000 mt or less, and it is expected that in many years no winter apportionment will be made. When available it may be harvested from October 1 through March 31 throughout the management area.

1.4.5 Foreign fishing or retention of herring prohibited

Herring is a prohibited species to all foreign fisheries operating in the Bering Sea/Aleutian Islands management unit. No allocation to TALFF shall be made, and no herring caught incidentally in any fishing operations may be retained. All herring, including the PSC, must be immediately returned to the sea.

1.5 Management Measures for Domestic Fisheries

1.5.1 Inshore commercial fishery

Regulations for the orderly conduct of the inshore commercial fishery are promulgated by the State of Alaska Board of Fisheries and are not provided for in this plan.

1.5.2 Offshore commercial fisheries

1.5.2.1 Seasons

The FCZ summer fishing season runs from July 1 through September 30. Fishing for herring during this period is allowed only south of 55°47'N latitude.

The FCZ winter fishing season runs from October 1 through March 31. Fishing for herring during this period is allowed throughout the FCZ management unit.

The Regional Director may adjust the seasons and areas open to fishing as necessary to protect herring stocks or prevent the harvest from exceeding the summer or winter apportionments of OY.

1.5.2.2 Herring Savings Area/AIC

AIC is part of the herring OY. All or part of the Herring Savings Area as described in Section 8.3 will be closed to herring and groundfish trawl fisheries by the Regional Director, if:

(a) DAH (including AIC) has been harvested;

(b) The amount of remaining AIC can be harvested within one reporting period (one week).

At that point herring also becomes a prohibited species to domestic fishermen until April 1, which is the beginning of the next herring fishing year.

Once closed, the Herring Savings Area or any portion of it shall remain closed until April 1. Any closure of the Herring Savings Area will occur only between September 30 and April 1.

1.5.3 Other regulations

Regulations in the Bering Sea/Aleutian Islands Groundfish FMP for time and area closures shall also apply to all herring fisheries.

1.5.4 Statistical reporting requirements

All necessary information regarding inshore harvest and processing can be obtained from the State of Alaska. Due to the vast area of the FCZ which may be opened to herring fishing and the unknown distribution and composition of offshore stocks, it is critical that offshore harvest information be collected as well. Where information is not available from other sources, this FMP authorizes collection of catch and effort data from vessels harvesting herring in the FCZ.

1.5.5 Permit requirements

All U.S. vessels operating in the FCZ portion of the Bering/Chukchi Sea must have on board a permit issued by the Secretary of Commerce.

1.6 Management Measures for the Foreign Fishery

1.6.1 Herring fishing and retention of herring prohibited

Directed fishing for herring and retention of herring caught incidentally in the foreign groundfish fisheries are prohibited within the Bering/Chukchi Sea management area.

1.6.2 Incidental harvest

A Prohibited Species Catch (PSC) will be designated annually for each foreign nation with a groundfish allocation in the Bering Sea and is for the period April 1 to March 31.

All or part of the Herring Savings Area, as described in Section 8.3 will be closed to a foreign nation's groundfish trawl fisheries by the Regional Director, in consultation with the Council if:

(a) that nation has no remaining PSC; or

(b) the amount of remaining PSC available to that nation can be harvested within one reporting period (one week).

Any closure of the Herring Savings Area will occur only between September 30 and April 1. Once closed, the Herring Savings Area or any part of it shall remain closed until April 1.

1.6.3 Foreign reporting requirements

The operators of all foreign vessels must maintain an accurate log of catch and effort information in accordance with the requirements of the implementing regulations of the Bering Sea/Aleutian Islands Groundfish Fishery Management Plan and other Foreign Fishing Regulations, 50 CFR Part 611.

1.6.4 Permit requirements

All foreign vessels fishing for groundfish or processing herring harvested by U.S. catcher vessels in the FCZ must have on board a permit issued by the Secretary of Commerce, as required by the Magnuson Act.

1.7 In-season Adjustment of Time and Area

The Regional Director of the National Marine Fisheries Service, Alaska Region, or his designee, may issue field orders adjusting time and area restrictions.

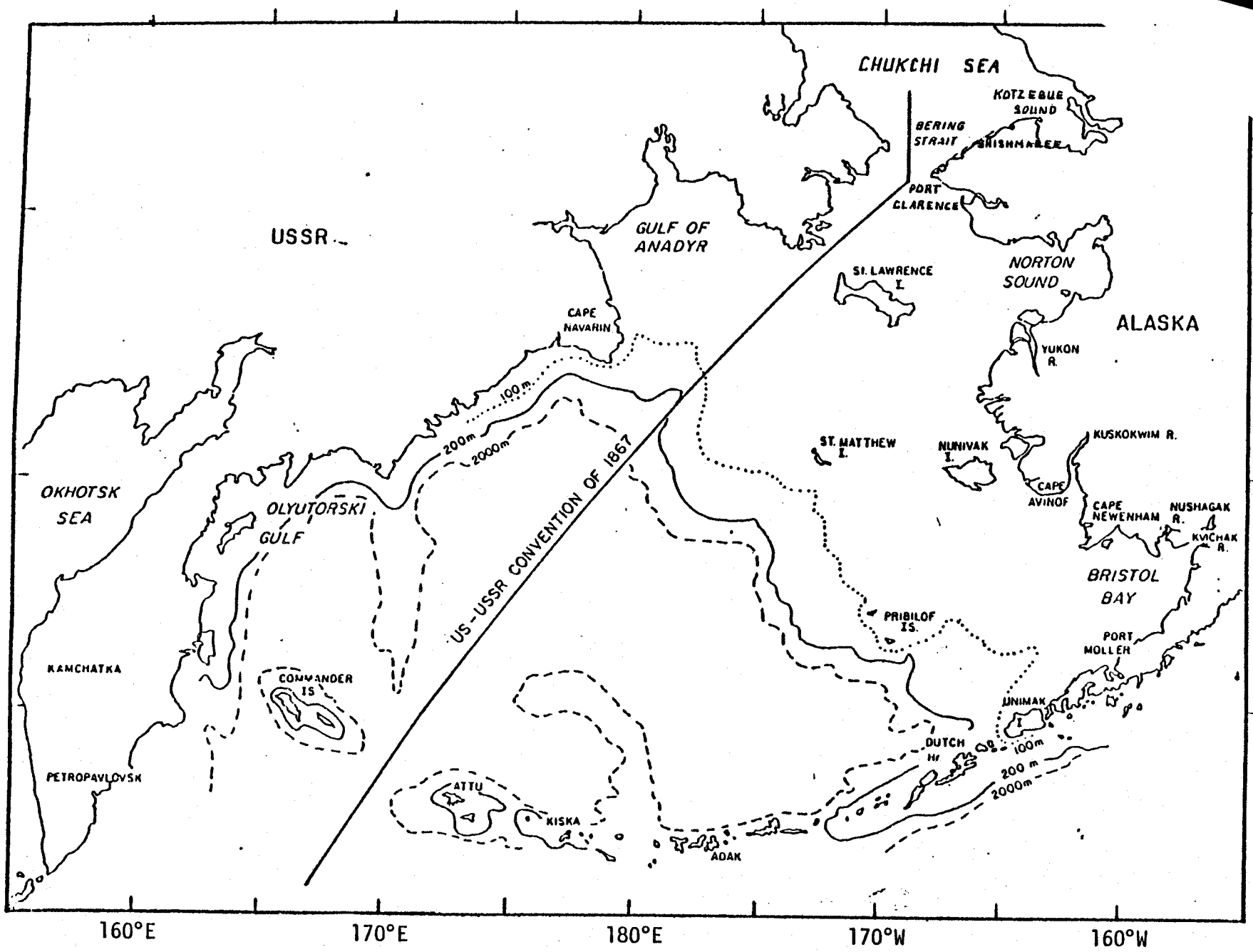

Figure 2-2. Geographical locations in the eastern Bering and Chukchi Seas.

the Fishery Conservation Zone (FCZ) and lie between three and two hundred miles offshore. Although this FMP devotes much discussion to the management regime and fishery occuring in State waters, it prescribes regulations only for waters of the FCZ.

In terms of both the fishery and the herring resource, the Bering Sea/ Chukchi Sea region forms a distinct management unit. The history of fisheries development, the species composition, the bathymetry, and the oceanography of this region are distinct from those of the adjacent Gulf of Alaska. Stocks of species common to both regions, with only a few exceptions (e.g. halibut and perhaps sablefish), are believed to be distinct and separate.

A description of the more prominent physical features of the planning region is included in the Bering Sea/Aleutian Islands Groundfish FMP. Figure 2-2 presents geographical locations in the Bering and Chukchi Seas.

2.2 Definition of Terms

a. Maximum sustainable yield (MSY). MSY is an average, over a reasonable length of time, of the largest catch which can be taken continuously from a stock under current environmental conditions. It should normally be presented with a range of values around its point estimate. Where sufficient scientific data as to the biological characteristics of the stock do not exist or the period of exploitation or investigation has not been long enough for adequate understanding of stock dynamics, the MSY will be estimated from the best information available. MSY applies to the combined state and federal management areas (see Section 7.6.1).

b. Acceptable biological catch (ABC). ABC is a seasonally determined catch based primarily on the ratio of the annual biomass estimate to the MSY biomass level. ABC may be less than, equal to, or greater than MSY, depending on resource conditions. ABC applies to the combined state and federal management areas (see Section 7.6.2).

c. Optimum yield (OY). OY is that portion of the biomass which is available for harvest in the FCZ (see Section 10.0).

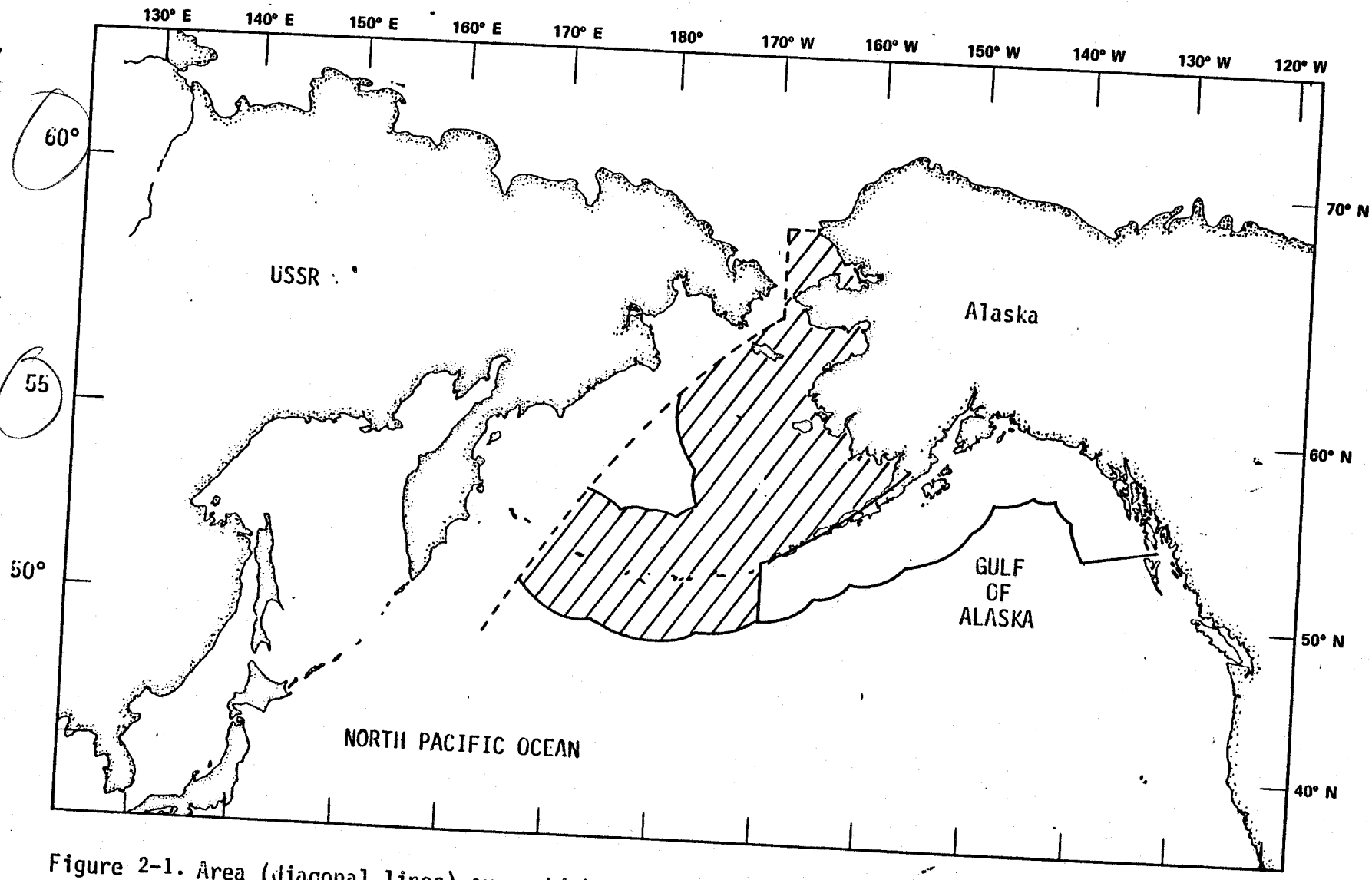

Figure 2-1. Area (diagonal lines) over which this Fishery Management Plan applies.

2.0 INTRODUCTION

This Fishery Management Plan (FMP) has been developed by the North Pacific Fishery Management Council (NPFMC or Council) to manage the offshore fishery for Pacific herring (Clupea harengus pallasi) of the Bering Sea and Chukchi Sea. It replaces that portion of the Preliminary Fishery Management Plan for the Trawl Fisheries and Herring Gillnet Fishery of the Bering Sea and Northeast Pacific (PMP) which applies to this fishery. This FMP also governs the incidental catch of herring in the Bering Sea groundfish trawl fishery, a fishery which is otherwise governed by the Bering Sea/Aleutian Islands Groundfish FMP (Groundfish FMP). This FMP was developed by the Council and submitted to the Assistant Administrator for Fisheries (Assistant Administrator), National Oceanic and Atmospheric Administration (NOAA), United States Department of Commerce, for approval and implementation by regulation under the Magnuson Fishery Conservation and Management Act, Public Law 94-265, as amended (Magnuson Act). The Assistant Administrator directs the National Marine Fisheries Service (NMFS).

2.1 Description of the Management Unit

The Bering Sea/Chukchi Sea region for the purposes of this plan is defined as those waters under Federal fishery management jurisdiction adjacent to the territorial waters of the State of Alaska lying south of Point Hope in the Chukchi Sea, east of the U.S./USSR convention line of 1867, and extending south of the Aleutian Islands between the convention line and 170°W. longitude (Figure 2-1). Waters lying south of lines joining headlands in the Aleutian Islands east of 170°W. longitude are considered a part of the Gulf of Alaska management unit.

Because the herring resource occurs in both state and federal waters at different times of the year, the management regime for both must be considered jointly if they are to complement one another and be effective in achieving effective conservation of the herring resource.

Waters under State jurisdiction lie within a boundary line that follows the coastline three miles offshore. Waters under Federal jurisdiction are termed

d. Domestic annual fishing capacity (DAC). DAC is the total potential physical capacity of United States fishing fleets, modified by logistic factors to harvest the OY during the fishing year. The components of the concept are:

(1) An inventory of total potential physical capacity, defined in terms of appropriate vessel and gear characteristics (e.g., size, horsepower, etc.).

(2) Logistic factors determining total annual fishing capacity, (e.g., variations in vessel and gear performance, trip length, etc.) (see Sections 9.2-9.5).

e. Expected domestic annual harvest (DAH). DAH is an estimate of the amount of the OY that will be harvested during a fishing year by United States fishing vessels. It is the sum of DAP and JVP (defined below), and is derived by assessing the extent to which DAC will be utilized in light of market conditions and other economic factors (see Sections 9.2-9.5). DAH is equal to OY.

f. Domestic annual processing capacity (DAP). DAP is the estimated portion of DAH that is expected to be processed by U.S. fish processors. It is determined primarily on the basis of surveys of the intent of United States processors (see Sections 9.2-9.5).

g. Joint venture processing capacity (JVP). JVP is that portion of DAH which is in excess of DAP and is therefore permitted to be delivered to foreign processors who are authorized to receive such U.S. harvested fish in the FCZ (see Section 9.6).

h. Allowable incidental catch (AIC). AIC is that amount of herring allocated to be taken incidentally to the United States groundfish fishery. It is a part of the OY for the herring resources, and it is accounted for the determination of the winter apportionment of OY (see Sections 8.3 and 10.1).

i. Total allowable level of foreign fishing (TALFF). TALFF is an estimate of that part of the OY from a fishery which will not be harvested during a fishing year by United States fishing vessels. Since the herring resource is fully utilized by domestic fishermen, this FMP establishes herring TALFF equal to zero (see Section 11.0).

j. Prohibited species catch (PSC). Each foreign nation is prohibited from causing excessive fishing mortality on herring by its groundfish trawl operations. The maximum allowed incidental mortality is called the Prohibited Species Catch (PSC). No foreign nation may retain any herring harvested as PSC. Each foreign nation's PSC is designated annually as 0.10% of its groundfish allocation under the FMP for Groundfish in the Bering Sea/Aleutian Islands Area.

3.0 DESCRIPTION OF THE FISHERY

U.S. nationals are currently harvesting herring for both subsistence and commercial purposes in the Bering/Chukchi Sea. The subsistence fishery has a long and consistent history of activity, while commercial fishing has been active in recent times. USSR and Japanese fishing fleets have operated in offshore waters since the early 1960's. Foreign harvests have declined significantly since the mid-1960's due to a reduction of the herring resource and restrictions imposed by the U.S. Government for conservation purposes.

3.1 Domestic Subsistence Fishery

3.1.1 General description of fishery

Herring are currently utilized by residents in many coastal communities throughout the region and subsistence harvests vary considerably by location (Figure 3-1). Herring are more important as a subsistence item to residents in the Yukon-Kuskokwim Delta with the greatest utilization occurring in the Nelson Island area. The greater dependency of Nelson Island residents is the result of several factors including the availability of herring, the absence or low abundance of alternative food resources (salmon, moose, etc.) and few employment opportunities (Barton 1978).

The spring fishery commences with the arrival of fish immediately following ice breakup (late May - early July) and lasts for only a short period of time ranging from a few days to three weeks. For example, Nelson Island residents may fulfill their subsistence needs during three or four days of intensive fishing when herring are abundant, although a longer period of time, about one week, is required to process and hang a family's herring catch taken during the spring. A greater period of time is required to catch and process an adequate volume of herring under conditions of low herring abundance or inclement weather.

Residents of villages in close proximity to important spawning grounds tend to utilize herring more extensively as a subsistence item. In some cases, an

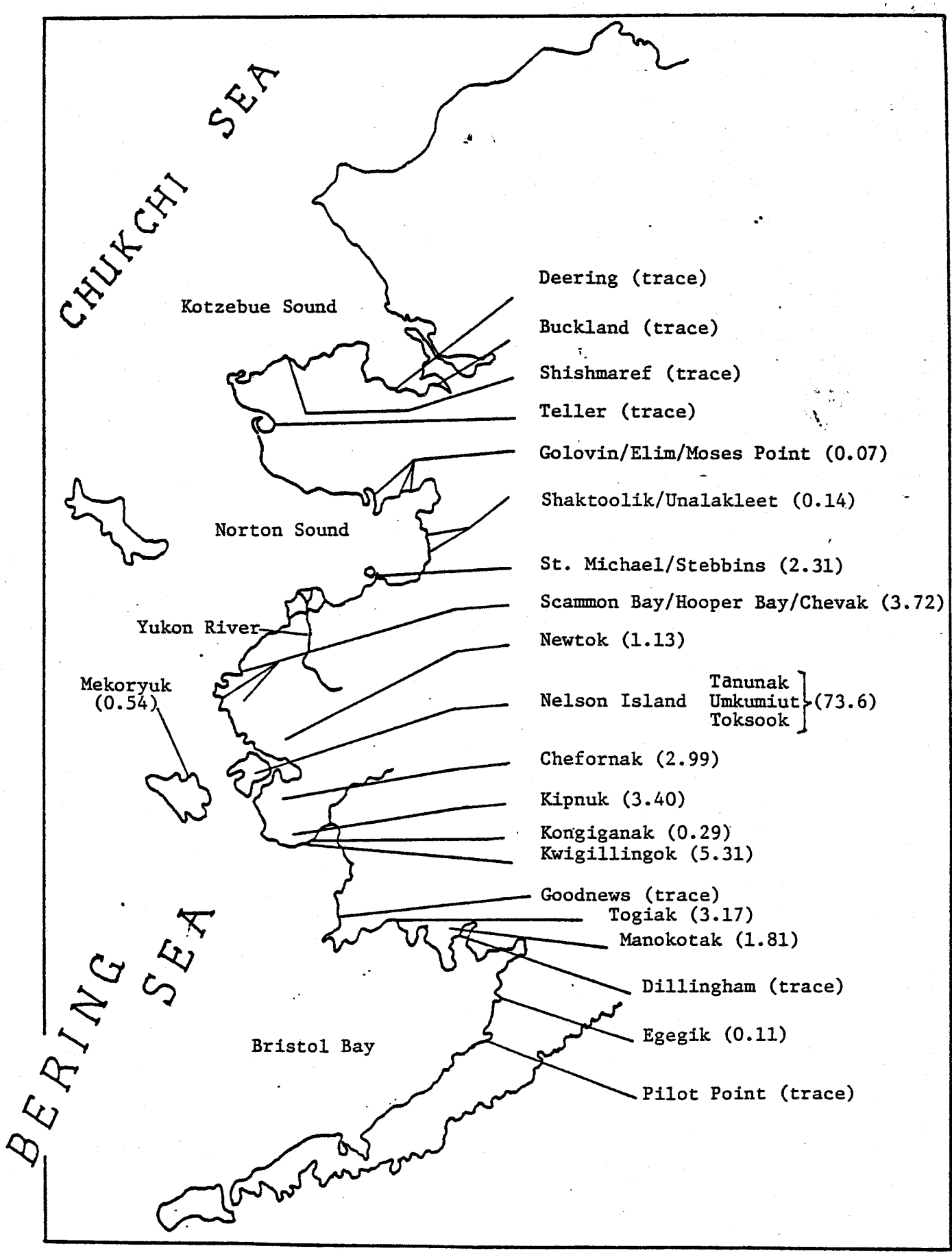

Figure 3-1. Average annual subsistence herring harvests in metric tons, eastern Bering -Chukchi Sea, 1975-1978.

entire village may temporarily relocate to such areas to meet their subsistence needs. For example, the residents of Nightmute move each spring to a temporary summer site on Nelson Island called Umkumiut. In still other instances, a few people will travel to spring herring areas, fish and return home after sufficient catches have been made. Examples include Mekoryuk residents fishing at Nelson Island, Unalakleet residents fishing at St. Michaels, and Wales residents fishing in Shishmaref Inlet.

Most subsistence caught herring are utilized for human consumption and there is generally little wastage as both the fish and the roe are kept for food. Wastage occasionally occurs when drying herring spoil as a result of inclement weather and excessive rain. Spring-caught herring are generally woven into grass strings and draped over wooden racks to sun-dry for several days, although a few may be smoked or preserved in seal oil as "poke herring". The latter process involves herring with a high oil content, which will not dry properly. Herring roe is also air dried on racks, drift wood or other dry surfaces.

Herring taken during late fall and winter are often eaten raw after freezing and slicing into small pieces. Some are fed to dogs, especially in villages farther north where dog teams are more common. Herring spawn on rockweed kelp is also harvested but on a small scale. Its use is primarily confined to the area south of Nome.

A comprehensive review of the subsistence herring fishery is presented in a report by Hemming et al. (1978) on the "Social and Economic Impacts of a Commercial Herring Fishery on the Coastal Villages of the Arctic/Yukon/ Kuskokwim Area."

3.1.2 Description of vessels and gear

Hemming et al. (1978) report that the 19th Century Eskimo of Norton Sound and more northerly coastal areas used small mesh beach seines to catch herring, while those in the Yukon-Kuskokwim delta employed gillnets, seines and dip nets. The nets were hand-made of sinew. Hemming also reported that boats or kayaks were not used to assist in either beach seining or gillnetting during this period of history.

In more recent years herring have been primarily harvested with gillnets although beach seines are used in northern areas to a limited extent. Many areas are not conducive to beach seining due to coastal morphology and thus gillnets provide the most practical means of harvest. Gillnets in the Nelson Island area range from six to eight feet in depth and from eighteen to sixty feet in length. Nets operated in other areas may be up to 300 feet in length. The stretched web measurements of most gillnets operated throughout the region range from 2-1/4 to 2-1/2 inches. The nylon gillnets presently in use may be purchased directly from US net suppliers or locally constructed from purchased materials or from salvaged Japanese nets found washed ashore.

Most vessels used for subsistence herring fishing are locally constructed outboard powered wooden skiffs ranging from 14 to 22 feet in length. The purchase and use of small aluminum boats are increasing.

All herring spawn-on-kelp utilized for subsistence purposes is harvested in intertidal and shallow subtidal areas by hand picking.

3.1.3 Catch trends

The first subsistence herring harvest surveys in the eastern Bering-Chukchi Sea were conducted from 1975 through 1977 by the Alaska Department of Fish and Game (ADF&G) as part of the Outer Continental Shelf Environmental Assessment Program (OCSEAP). Dames and Moore, an environmental consulting firm, conducted an additional subsistence herring harvest survey in 1978 for the NPFMC. The 1978 survey was more comprehensive in scope in that the social, economic and nutritional value of subsistence herring to local residents was examined. The earlier surveys were designed only to document the level of subsistence herring harvests.

Similar survey methods were used throughout the 1975-1978 period. Local residents were informed of the scope and purpose of the study prior to each season's field survey. This information was disseminated by a variety of media including correspondence with village council members, broadcasts over local radio stations and public meetings conducted in selected villages. Catch documentation was obtained from interviews of individual fishermen,

often employing a local resident to collect this information in many of the Yukon-Kuskokwim delta communities. In many instances fishermen recorded their own catches on special forms provided by the ADF&G and these were collected at the end of the fishing season by survey personnel.

Despite this extensive survey effort, it has been difficult to accurately quantify the amount of subsistence herring harvested for the following reasons: (1) some villages were not included in all the surveys or failed to respond; (2) the survey method relies on the people's memories of fish caught and on their ability to accurately record catches on specially provided forms; (3) fishermen commonly report their catches in units of "tubs" or "strings" and the required conversions to pounds are a source of error; (4) some fishermen may exaggerate the size of their catch to assert their competence as a fisherman or to establish a larger collective claim to subsistence resources. The cumulative effect of these factors on the reported catch is not known, but the harvests recorded in this manner are considered to have a degree of error of not more than 25%.

Survey results indicate that the annual subsistence herring harvest for the eastern Bering/Chukchi Sea region averaged approximately 100 mt during the 1975-82 period (Table 3-1). Annual harvests made in the Nelson Island area, primarily by residents of Tanunak, Toksook Bay and Nightmute (Umkumiut) accounted for 74% of this harvest. The Nelson Island harvest amounted to an average annual catch of about 2,000 pounds for each fisherman (head of household) or 220 pounds per capita.

Total catches recorded for Nelson Island villages, which have been surveyed annually since 1975, have increased steadily since 1976 although individual villages do not show any discernible catch trends (Table 3-1). Annual fluctuations in harvests can be caused by factors other than resource abundance. These include: (1) weather and ice conditions; (2) the availability of employment opportunities; (3) harvests of alternate food resources; and (4) the size of herring. (Size is critical to the subsistence fishery because the gillnets are selective to large, mature herring. In years when the age composition is predominatly less than age 5, most herring will pass through the gillnet washes without being gilled.)

Table 3-1. Subsistence herring catch (in metric tons) and effort data by selected areas, eastern Bering Sea, Alaska, 1975-1982. 1/

Village	1975	1976	1977	1978	1979	1980	1981	1982
				Nelson Island				
Tununak	19.8	13.9	51.9	34.6	31.0	59.2	36.0	43.8
Umkumiut	30.0	8.5	2.8	10.4	7.5	3.1	9.0	0
Toksook Bay	31.0	31.8	19.3	33.5	46.5	26.6	13.0	31.6
Total	80.8	61.2	74.0	78.5	85.0	88.9	58.0	75.4
Number of Fishing Familes	109	42	90	83	54	70	93	65
				Yukon-Kuskokwim Delta				
Scammon Bay	-	0.6	-	0.6	5.4	2.8	6.9	3.5
Chevak	-	0.6	0.1	-	2.1	3.2	1.7	1.8
Hooper Bay	2.5	2.7	2.1	3.5	2.8	3.3	3.6	4.2
Kwigillingok	-	9.6	0.9	-	7.2	12.0	-	12.0 2/
Total	2.5	13.5	3.1	4.1	17.5	21.3	12.2	21.5
Number of Fishing Families	34	49	39	29	106	80	45	64
				Areas Combined				
Total Catch	83.3	74.7	77.1	82.6	102.5	110.2	70.2	96.9
Number of Fishing Families	143	91	129	112	160	150	138	129

1/ Other areas with small catches have been surveyed irregularly (1975-1978 estimated total coastal yearly subsistence catch averaged 100 m.t.).

2/ Estimate based on post season observations.

Source: ADF&G

The lack of quantifiable catch data prior to 1975 makes it difficult to identify long-term catch trends or the reasons for such trends. It has been reported that herring utilization was greater in earlier times when the fish were more abundant and subsistence requirements were greater, partly because of the need to feed a larger number of sled dogs.

3.1.4 Value of subsistence catch

The nominal value of the subsistence harvest taken by any particular village can probably best be estimated by computing the replacement cost of an alternative source of protein. In areas where subsistence protein other than herring is readily available, the value of the herring harvest would be quite low and difficult to quantify. In an area such as Nelson Island where it would be necessary to import a protein replacement, the cost is more easily calculable. The current subsistence herring harvest on Nelson Island averages in excess of 2,000 lbs per family. This harvest could be replaced on a pound-for-pound basis with salmon at a cost of roughly $2 per lb. The average family's herring harvest, calculated in this manner, would be worth about $4,000, a figure which probably exceeds the median family income in the Nelson Island area.

This nominal value is not adequate to assess the total value of the subsistence herring harvest. Eskimos of the coastal communities have been fishing for hundreds of years. During that time a way of life has been established with fishing as a very central part. Many of the tools and methods that were developed many years ago are still used today. It is this cultural dimension of all subsistence activities which makes them irreplacable and unmeasurable in dollar terms.

3.2 Domestic Commercial Fishery

3.2.1 General description of fishery

Documented utilization of herring by American fishermen in the Bering Sea dates back to near the turn of the century (Table 3-2). An inshore commercial fishery developed about 1909 at Golovin Bay in Norton Sound (Rounsefell 1930).

Table 3-2. Herring and herring spawn on kelp harvests in metric tons by U.S. commercial fishermen in the eastern Bering Sea. 1909-1982.

Year	Herring[1/]						Herring Spawn on Kelp		
	Unalaska Island	Bristol Bay	Security Cove/ Goodnews Bay	Cape Romanzof	Norton Sound	Total	Bristol Bay	Norton Sound	Total
1909-1916					2/	2/			
1916-1928					1,705.6	1,705.6 3/			
1929	1,141.9				151.3	1,293.2			
1930	1,738.2				399.7	2,137.9			
1931	957.9				78.2	1,036.1			
1932	2,276.9				480.0	2,756.9			
1933	1,438.2				27.8	1,466.0			
1934	1,390.9				3.5	1,394.4			
1935	2,188.0				14.1	2,202.1			
1936	1,251.1					1,251.1			
1937	525.4				5.0	530.4			
1938	465.5				9.0	474.5			
1939					5.0	5.0			
1940					12.7	12.7			
1941					3.4	3.4			
1942-1944									
1945	68.0					68.0			
1946									
1947-1963		- NO COMMERCIAL OPERATIONS REPORTED -							
1964					18.1	18.1			
1965		- NO COMMERCIAL OPERATIONS REPORTED -							
1966					10.8	10.8			
1967		122.0				122.0			
1968		82.4				82.4	24.8		24.8
1969		42.8			2.0	44.8	4.6		4.6
1970		25.0			7.3	32.3	17.6		17.6
1971					17.7	17.7	23.6		23.6
1972		73.7			15.3	89.0	29.1		29.1
1973		46.3			32.3	78.6	5.3		5.3
1974		111.7			2.4	114.1	57.0		57.0
1975		50.4				50.4	50.4		50.4
1976					7.7	7.7	134.1		134.1
1977		2,534.9			9.5	2,544.4	125.1	trace	125.1
1978		7,030.4	259.0		13.6	7,303.6	149.6	3.4	153.0
1979		10,115.3	466.0		1,173.0	11,754.3	188.0	11.8	199.8
1980		17,774.0 4/	1,039.0	554.0	2,215.4	21,582.4	86.0	22.2	108.2
1981	639	11,374.3	1,660.2	653.2	3,964.5	18,291.2	171.8	37.2 5/	209.1
1982 6/	3,233.6 7/	19,566.0	1,178.0	596.0	3,567.0	27,836.0	106.5	34.9	141.4

1/ Prior to 1964 majority of herring catch was taken in summer and fall for food market. Since 1964 majority of herring catch was taken in spring primarily for marketing of roe.
2/ Fishery occurred some years, but harvests unavailable.
3/ Total catch for all years.
4/ There was an additional estimated 5,200 metric tons of wastage.
5/ Does not include 5 mt dumped (unmarketable or no market when harvested).
6/ Preliminary data.
7/ An additional 458 mt was harvested near Port Moeller.

This early fishery concentrated on nonspawning fall run herring which were salted and pickled using Norwegian techniques. Later in an attempt to improve product quality, Scotch cured methods were employed (Bower, 1917-1938). A similar pickled herring industry was initiated in 1928 at Dutch Harbor on Unalaska Island (Bower 1917-1938, Fish and Wildlife Service 1939-1946). These early ventures were terminated in the early to mid 1940's.

Following an extended period of inactivity, domestic commercial utilization of spawning herring, primarily for the marketing of sac roe, resumed in portions of the eastern Bering Sea during the 1960's (Figure 3-2). The recent fishery in Norton Sound, which began in 1964, was of a limited and sporadic nature until 1979 when 1,173 mt was taken. Since then harvest has consistently been at least 2,000 mt. Inshore commercial fishing in the Togiak district of Bristol Bay was initiated in 1967 and continued on a limited and sporadic basis until 1977 when 2,535 mt were taken. In 1982 a record harvest of 19,556 mt was made in this district (the 1980 harvest was 17,744 plus an estimated wastage of 5,200 mt). The Security Cove and Goodnews Bay districts, located immediately north of Bristol Bay, were fished for the first time in 1978 and in 1982, 1,178 mt was harvested. A fishery occurred in the Cape Romanzof district for the first time in 1980 when 554 mt was harvested. The 1982 harvest was 596 mt.

A herring spawn-on-kelp fishery originated in Bristol Bay in 1968 and has operated annually since that time. Limited spawn-on-kelp harvests have also been made in Norton Sound since 1977. The product being harvested is almost entirely rockweed kelp (Fucus sp). During the 1982 season in Bristol Bay, eight companies purchased spawn-on-kelp from 214 fishermen.

The sac roe fishery in Bristol Bay has been of less intensity and longer duration in comparison to sac roe herring fisheries elsewhere in the State. In years when weather and ice conditions allow, spawning herring are usually present from early May into the early part of June. The fisheries are regulated on an emergency opening basis, with openings ranging from several hours to several days. In 1982 the Togiak season lasted 36 hours for purse seine vessels and 60 hours for gillnet gear. The spawn-on-kelp fishery begins somewhat later and, after a peak that normally occurs in late May. This fishery is also managed in-season.

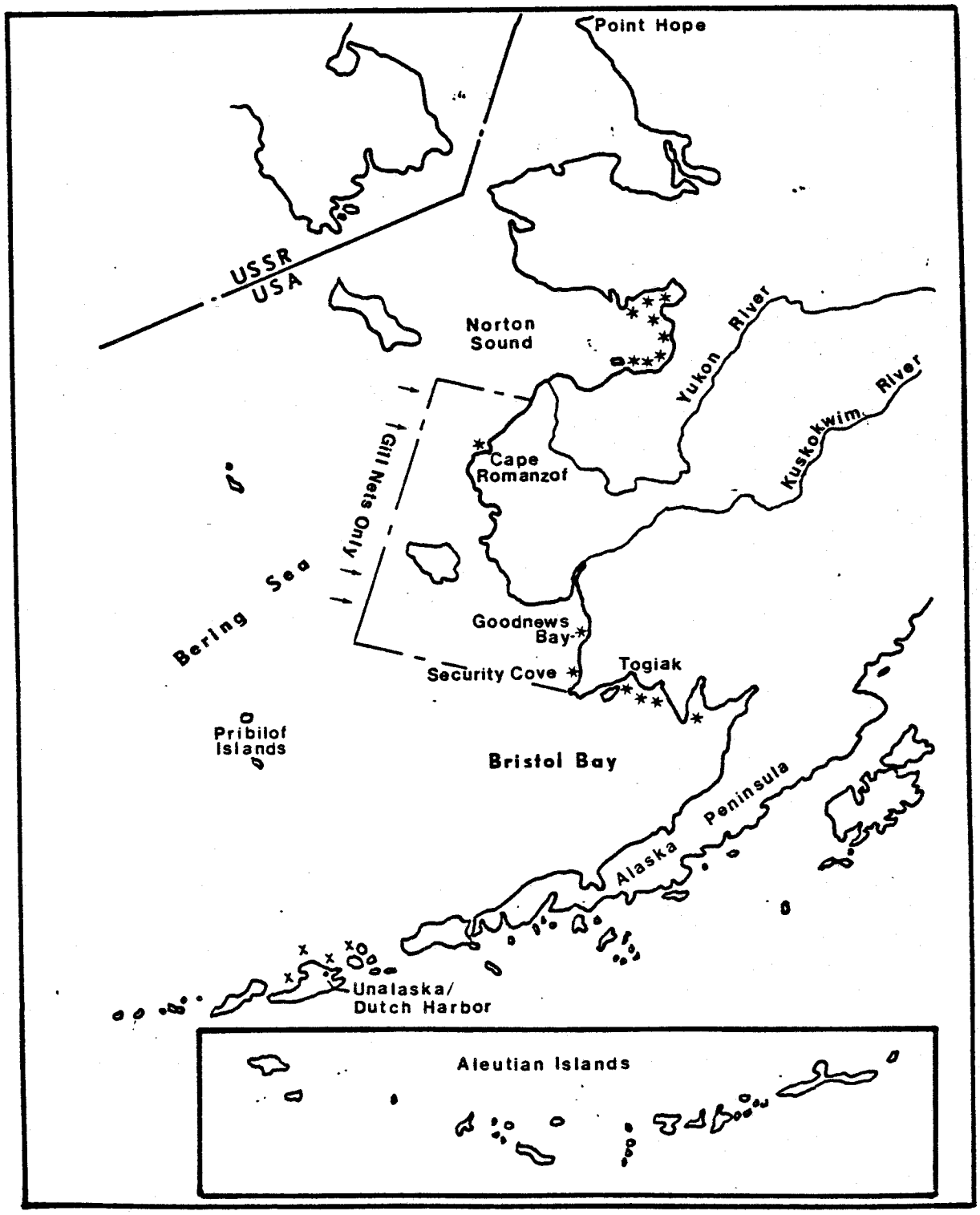

Figure 3-2. Major inshore herring fishing areas.

* * * * Roe Fishing Areas
x x x x Summer Food/Bait Areas

A total of 19,556 mt of herring was harvested in the Togiak district during 1982, and a total of 24,897 mt was harvested in all of Western Alaska. The purse seine catch in Togiak totaled 13,500 mt or 69% of the total harvest. The gillnet fleet accounted for 6,056 mt or 31% of the total harvest as compared to 18% in 1981. Most of the harvest in 1982 (18,380 mt or 94%) was categorized as sac roe herring. The remainder was purchased for either the food or bait markets.

Effort levels in 1982 were below the record levels observed during 1979. (Table 3-3). A total of 135 purse seine and 200 gillnet vessels were estimated to be present during 1982 as compared to 175 and 350 respectively during 1979. A total of 33 processing companies were present during 1982, the same number as in 1979.

3.2.2 Description of vessels, gear and user groups

The sac roe fishery in Bristol Bay has evolved rapidly although fishermen and processors are still experimenting with the type of vessels and gear most suitable for this area. Purse seine nets range in length from 120-150 fathoms and vary in depth from two to four strips (200 meshes/strip) depending on fishermen preference and fishing methods. Gillnetters have been most successful with set nets in lengths from 50-150 fathoms with varying floatline weights, depths and mesh sizes (2-1/4" to 2-1/2" stretch measure), depending on local regulations.

Bristol Bay purse seine vessels normally have a crew of four and range from 30-50 feet in length. Some of the more successful fishermen operated 30 foot welded aluminum vessels. Properly rigged small vessels can be efficiently used in the herring fishery because the fishing boat does not take the catch aboard as the fish are pumped directly from the seine into tenders. Gillnet vessels range from 16-20 foot outboard powered skiffs to 36 foot power boats.

Norton Sound and Cape Romanzof fishermen operate gillnets of similar specifications although beach seines have been used in some years. Fishermen in this area operate outboard powered skiffs ranging in lengths from 16 to 22 feet.

TABLE 3-3. Inshore commercial catch of sac roe herring in the Togiak district, Bristol Bay, 1967-1982.[1/]

Year	Number Processors	Units of Gear		Catch in Pounds			M. Tons
		Gill Net	P. Seine	Gill Net	P. Seine	Total	
1967	1	27	0	268,902	0	268,902	122
68	2	35	2	136,900	44,865	181,765	82
69	2	22	1	36,231	58,250	94,481	43
70	3	16	1	37,195	18,000	55,195	25
71	0	0	0	0	0	0	0
1972	1	18	1	64,929	97,505	162,434	74
73	2	26	1	102,147	0	102,147	46
74	3	10	1	38,256	208,000	246,256	112
75	2	39	0	111,185	0	111,185	50
76	0	0	0	0	0	0	0
1977	6	43	6	614,839	4,974,610	5,589,449	2,535
78	16	40	25	1,240,158	14,261,821	15,501,979	7,032
79[2/]	33	350	175	8,939,528	13,364,102	22,303,630	10,117
80	27	363	140	6,188,376	32,996,586	39,184,961	17,774[4/]
81	28	106	83	4,535,129	20,536,500	25,071,629	11,372
82[3/]	33	200	135	13,345,683	29,767,035	43,112,718	19,556
1967-'76 Avg.	2	19	1	79,575	42,662	122,237	55
1977-'82 Avg.	24	184	94	5,810,619	19,316,776	25,127,395	11,398

1/ Catch not entirely comparable, as harvest prior to 1973 reflects females only; most males were discarded and not weighed. The 1973-79 catches include both sexes.

2/ Number of units of gear inflated by an unknown percentage due to fraudulent information given on fish tickets. Many fishermen attempted to document their participation in the 1979 fishery in an effort to gain points for possible future limited entry.

3/ Preliminary.

4/ Does not include an estimated 5,200 mt of wastage.

Tenders are an integral part of the fishery and processing operations in Bristol Bay. Vessels used for tenders are of all descriptions, typically over 80 feet in length. Several 85 foot class crabbers were among the vessels used for tenders (Hemming et al 1978).

The purse seine fleet is manned primarily by fishermen who are not resident to the local area, while the opposite is true of the gillnet fleet. Virtually all boats available locally are a maximum of 32 feet and are designed for salmon gillnet fishing. To date, only a few vessels in this fleet have been converted to handle purse seines, but a large potential exists for adapting these boats for fishing other types of net gear.

Most fishermen taking spawn-on-kelp rely on some type of hand operated stiff-pronged rake for gathering this product from accessible beaches at low tide. A few fishermen also pick the kelp and use rakes from their skiffs when the water is too deep for wading. The spawn-on-kelp fishery is very labor intensive and the harvest is taken predominantly by residents of Bristol Bay communities.

3.2.3 Catch trends

Harvest trends during the earliest years of herring fishing in Golovin Bay and Unalaska Island varied widely over the life of those fisheries. After more than 20 years of sporadic and limited production, a decline in market demand for salted and cured herring products led to the demise of these fisheries during the 1940's. Total production for all years was less than 3,000 mt and 15,000 mt for the Golovin Bay and Unalaska Island fisheries respectively (Table 3-2).

Annual variations in fish abundance, adverse weather and ice conditions, low percentage roe recovery, logistical difficulties of operating in remote areas and low market prices have discouraged development of commercial herring fisheries in the eastern Bering Sea during the last decade. The resultant production of the sac roe fishery, excluding the 1977-1982 seasons in Bristol Bay, has been small and not indicative of herring abundance.

The total production from the Norton Sound sac roe fishery since 1964 has amounted to only 11,056.6 mt (Table 3-2) with about 68% of that being taken in 1981 and 1982.

A total harvest of 555 mt was made in the Bristol Bay sac roe fishery through 1976. The maximum annual fishing effort during this time consisted of 2 seine and 39 gillnet gear units. Expansion of fishing and processing effort resulted in greatly increased harvests of 2,545 in 1977 to 19,556 in 1982 (Table 3-3). This recent expansion in the Bristol Bay fishery is the result of favorable market conditions and prices created by the worldwide herring shortages in addition to protection given to American fishermen under the Magnuson Act.

Annual production of the spawn-on-kelp fishery in Bristol Bay has varied as a result of fluctuating effort in addition to product availability and quality. Expansion in fishing effort and processing capacity resulted in increased harvests after 1976 with a record harvest of 188 mt made during 1979. Subsequent harvests have been restricted by State regulations.

3.2.4 Value of catch

In 1982 the ex-vessel values of herring sac-roe from the Bering Sea was estimated at $7.6 million. The price paid to fishermen averaged about $306/mt but varied according to roe content. Roe content averaged 8.9% and buyers generally adjusted the price about $40/mt for each percent change. Japanese vessels were permitted to enter state waters in the Togiak district in order to buy herring from gillnetters who had complained about marketing procedures in the past. These buyers reportedly paid up to $600/mt.

Tendering herring during the sac-roe fishery produces a significant source of income for owners of suitable vessels; however, data on the amount of income generated is not available. Some tenders are chartered by processors, some are paid daily rates, and some are paid by the ton.

The 1982 ex-vessel value of spawn-on-kelp was estimated at $233,778 and fishermen received an average price of about $0.75 per lb. The price varies

according to the layers of eggs present and can also be affected if sand is present in the product to a noticeable degree.

The ex-vessel value of the 1982 summer food and bait fishery in the Aleutians area was estimated at approximately $1.2 million. Price averaged about $330/mt, with food herring bringing between $110 and $330/mt and bait herring bringing between $264 and $660/mt.

3.2.5 Processing of products

In 1982 all herring taken in the Bering Sea sac-roe fishery were either salted or frozen on support vessels. In 1981, the Norton Sound Cooperative at Unalakleet removed and packaged roe but did not handle herring in 1982. Other canneries along the coast are not operating at the time the sac-roe fishery occurs. Some of the product is tendered to Kodiak or Seward for final processing but the majority of the catch is shipped directly to Japan for final processing.

Spawn-on-kelp is usually processed and packaged by local buyers although some is processed by the pickers themselves. Processing consists simply of salting and packing into five gallon containers.

Herring harvested during the August/September 1982 food and bait fishery in the Aleutian Islands area were taken to Dutch Harbor or Akutan for processing at shore-based plants or floating processors which remained in port. That portion sold for food was exported to Japan or Korea while the portion sold for bait was utilized locally. Since herring are feeding heavily at this time, prompt handling and chilling are crucial to insure quality. During the 1940's when the catch was salted, herring were "pounded" in the net until their digestive tracts were empty, thus eliminating the "belly burn" (spoilage) problem. Some consideration has been given to reinstituting this technique.

3.2.6 Markets (domestic and export)

3.2.6.1 Herring roe market

The market for herring roe is exclusively Japanese, where the product is called kazunoko. Kazunoko is a delicacy item served primarily during the New Year celebrations. The purchase of herring roe from the U.S. has more than doubled since 1977 (Table 3-4), although only a portion of this is from the eastern Bering Sea.

The ex-vessel and retail prices for herring roe have varied substantially over the past six years. The retail price in Japan in 1978 was $14.02-14.99 per lb., a 20% increase over 1977. However, in early 1980 the roe market collapsed as consumers reacted against the spiralling price. At the same time a report was published linking the peroxide bleaching agent used in processing with an increased incidence of cancer. Since 1980 existing inventories from the previous season have greatly influenced prices, as have foreign currency exhange rates.

The Japanese market for eastern Bering Sea herring roe will probably continue to be somewhat unstable. Since herring in this region spawn last among the North American stocks, the market may occasionally be satiated prior to the season opening. On the other hand, the industry has a potential advantage by having opportunity to analyse prevailing prices and buying trends coastwide, and thus may be better able to plan their season strategy.

3.2.6.2 Roe (spawn)-on-kelp

Herring spawn-on-kelp is exported from Alaska to both Hawaii and Japan, the latter taking most of the available product in recent years. The U.S. supplies approximately three-fourths of the Japanese import market for spawn-on-kelp, the balance coming from Canada. This market is primarily limited by the supply of an acceptable product. There should be a continuing market for any high quality spawn-on-kelp produced from Alaska.

Table 3-4. Japanese imports of herring and herring roe (in metric tons), 1975-1982.[1/]

HERRING IMPORTS

	Import Quota	Imports	USA	Canada	South Korea	Others
1975	13,000	8,853	1,615	7,238	--	--
1976	17,000	5,910	996	4,500	414	--
1977	58,000	30,634	8,725	21,392	502	15
1978	33,000	6,699	5,765	1,024	--	--
1979	40,000	13,742	6,431	6,195	479	637
1980	45,000	30,144	21,547	7,564	450	547
1981	45,000	50,118	22,343	23,452	188	4,135
1982	54,000	48,442	29,456[2/]	16,647	--	2,339

KAZUNOKO (Herring Roe) IMPORTS

Unprocessed Roe Import	1977	1978	1979	1980	1981	1982 (Oct.)
USA	713	669	1,090	1,439	1,768	1,492
Canada	8,767	7,575	5,548	2,293	4,185	4,634
Atlantic	--	--	--	--	--	370
South Korea	397	700	846	656	1,007	652
China	386	581	574	855	469	397
USSR/Others	12	20	70	173	216	115
TOTAL	10,275	9,545	8,128	5,416	7,645	7,660

1/ From Alaska State Asian Office Bulletin, January 7, 1983.
2/ Includes approximately 28,600 mt roe herring.

3.2.6.3 Food and bait markets

By the early 1950's, following the demise of the larger herring fisheries of the 1930's and 1940's, all major food and bait operations in the Bering Sea had ceased. Smaller localized operations continued to harvest herring for personal or commercial bait use, but these were generally not reported as commercial operations. As other fisheries such as crab and longline in the Bering Sea/Aleutian Islands area have grown, however, the demand for high quality fresh bait has also grown. Most of this demand has been satisfied by imports from the Gulf of Alaska, Canada, and other sources.

In the late 1970's the reported food and bait catch began to rise. In 1981 a directed food/bait harvest redeveloped in the Dutch Harbor area, and market response was very favorable. In 1982 the harvest increased to approximately 3,200 mt and is expected to remain near that level. The market demand for quality food herring, which are available in the summer and winter fisheries in the management unit, is expected to continue for the foreseeable future.

One market for Alaska herring is Europe where herring fillets are processed into specialty food products. Herring intended for this purpose should have superior flesh quality and high oil content. Fish in spawning or post-spawned condition are unsuitable for this purpose. Transportation cost has been an impediment to entering the market in the past.

Japan has imported substantial quantities of food herring in the past, along with larger quantities of roe herring (see Table 3-4). Markets in Japan and other far eastern countries will have to be explored further as harvests increase.

A large market in the Soviet Union also exists for food herring. U.S.-Soviet joint venture operations have repeatedly requested large allocations of herring on the wintering grounds. These joint venture operations were terminated in early 1980 when a court order declared herring a prohibited species to all joint venture and foreign harvesters.

The oil and meal produced from herring carcasses after roe extraction have been marketed domestically and used as livestock feed. The reduction plants which manufacture these products also utilize other raw products including shrimp and crab waste. Herring carcasses are a relatively small source.

Overall, Alaskan herring production, including that from Bering Sea stocks, has been and will probably continue to be dependent on the Japanese import market.

3.2.7 State and Federal revenues

The State of Alaska levies a raw fish tax on processors operating within the State. Because the Bering Sea fishery is a developing fishery, this tax is set at 1% of the ex-vessel value paid to fishermen instead of at the common rate of 4%. The estimated ex-vessel value of the 1979 catch was $8.2 million, thus, State revenues derived through the raw fish tax were approximately $82,000 for that year.

The State also obtains revenues through fees paid for gear permits, commercial fishing licenses, vessel licenses, and processor licenses. Though it is necessary to process these permits and licenses to participate in the Bering Sea herring fishery, they are not specific to that fishery or even to herring fisheries statewide. It would be inappropriate to attribute more than an insignificant portion of these revenues to a fishery as small as the one under consideration.

The Federal government levies poundage fees on the catch of foreign vessels operating in the FCZ. These fees are set equal to a percent of the ex-vessel value of the catch. In 1979, the poundage fee for herring was set at $5.70 per mt. The total foreign catch during that year was 8,700 mt, thus, the Federal government netted almost $50,000 for that year. Since retention of herring has been prohibited since 1980, no fees have been collected. The only fees expected will result from the Allowable Incidental Catch (AIC), which will never exceed 2,000 mt.

The Federal government also obtains permit fees from foreign vessels. These fees vary from year to year with changes in Federal legislation. No foreign vessels targeted on herring during the 1978-83 period and none are allowed to by this FMP, so no permit fees can be attributed to this fishery.

3.3 Foreign Fishery

3.3.1 General description of fishery

The Soviet Union and Japan have been the principal exploiters of eastern Bering Sea herring stocks. The only other nation to operate a herring fishery in the Bering Sea was the Republic of Korea (ROK) which operated a small trawl fishery consisting of one factory ship and four pair trawlers between Kuskokwim Bay and Norton Sound in 1973 and 1974. The estimated ROK catch of about 200 mt is not included in the catch data presented elsewhere in this plan.

The USSR had taken large quantities of herring in the western Bering Sea for many years, mainly utilizing stocks found close to the coasts of Kamchatka, in the western Bering Sea, and Sakhalin, in the Sea of Okhotsk. Some herring were reportedly also taken in the vicinity of the Gulf of Anadyr in Magadanskaya Oblast as early as 1936 (Law Enforcement and Surveillance Division 1965). The Japanese also operated a gillnet fishery in these areas from 1960 to 1968.

The development of the eastern Bering Sea herring fishery was partially due to reduced abundance of western Bering Sea herring (Forrester et al. 1978). The western Bering Sea fishery was closed after 1968 through a USSR-Japan bilateral agreement; the agreement apparently remained in force until the USSR adopted a 200-mile fishery zone. Japan is now prohibited from fishing for herring in the Soviet fishery zone and a Soviet fishery has not been reactivated in this area (Ikeda and Fadeev, pers. comm).[1/]

1/ Japan Fisheries Agency, Shimizu, Japan and TINRO, Vladivostok, USSR.

The Soviet fishery in the eastern Bering Sea began during the winter of 1959-60 with a factory ship and about 50 side trawlers and several refrigerated fish transports. Catch rates of 1-5 metric tons per hour were reported for March and April. In late April the herring concentrations were lost because of ice conditions and movement of the herring to the spawning grounds.

The Soviet fleet increased annually until 1964-65 when effort was twice that of 1959-60 (Table 3-5). At least 100 side trawlers, about 10 base ships of various types, a salvage tug, various refrigerated transports, and other support vessels were active on the herring grounds at the peak of this season. Adverse weather and heavy icing conditions reportedly were encountered in late January and by mid-February the fishery terminated.

Fishing effort in the 1965-66 and 1966-67 seasons was limited to about 5-15 trawlers due to the failure of reconnaissance vessels to locate large concentrations of herring. The failure of the 1965-66 and 1966-67 herring fisheries caused economic difficulties for the Soviet Far East fisheries because herring were a major source of income (Chitwood 1969).

Soviet effort began increasing again in the late 1960's and reached its peak during the 1969-70 to 1973-74 seasons based on the number and size of fishing vessels engaged in the fishery and the length of the season. Fishing during this period generally began in mid-to late November and continued to April. Areas fished by the Soviet fleet are depicted in Figure 3-3.

A Japanese trawl fishery for eastern Bering Sea herring did not develop until 1968. Figure 3-3 shows areas fished by the Japanese trawl fleet from the 1968-69 through the 1973-74 seasons. Prior to 1968 herring were taken incidentally in fisheries for other species. Japanese effort, as measured in number of boats, decreased after a peak in the late 1960s-early 1970s (Table 3-5). The Japanese trawl fishery generally began in late-November and continued through March-April.

In the first season (1968-69), 10 independent stern trawlers and two side trawlers fished and were supported by two factory ships that served as refrigerated transport vessels. In the following years the maximum number of

Table 3-5. Number of vessels in the Soviet and Japanese eastern Bering Sea herring fleet by month, 1964-1976.

Nation	Fishing year	Month							
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
U.S.S.R.									
	1964-65		30	120	120				
	1965-66		1/	15	15				
	1966-67		1	6	6				
	1967-68		1	14	31	30			
	1968-69		30	45	70	70	30		
	1969-70	6	80	81	105	1/	1/		
	1970-71	12	82	117	100	50	40		
	1971-72	29	50	90	80	60	1/		
	1972-73		25	65	66	40	40		
	1973-74	12	45	63	78	50			
	1974-75		45	50	45				
	1975-76 2/				30	39	39		
Japan									
	1966-67							1	1
	1967-68							17	17
	1968-69	14	14	14	14	14	14	24	42
	1969-70	6	1/	25	13		1	12	14
	1970-71	3	3	20	10			15	10
	1971-72	10	31	12	12	7	16	3	15
	1972-73		12	12			1/	13	15
	1973-74	4	4	12	12	12		8	11

1/ Vessels present but number unknown.

2/ Fleet also fishing for pollock.

Sources: NMFS Law Enforcement and Surveillance Division
Foreign Fisheries Activities Reports, 1964-1975.
INPFC Annual Reports, 1965-1977.

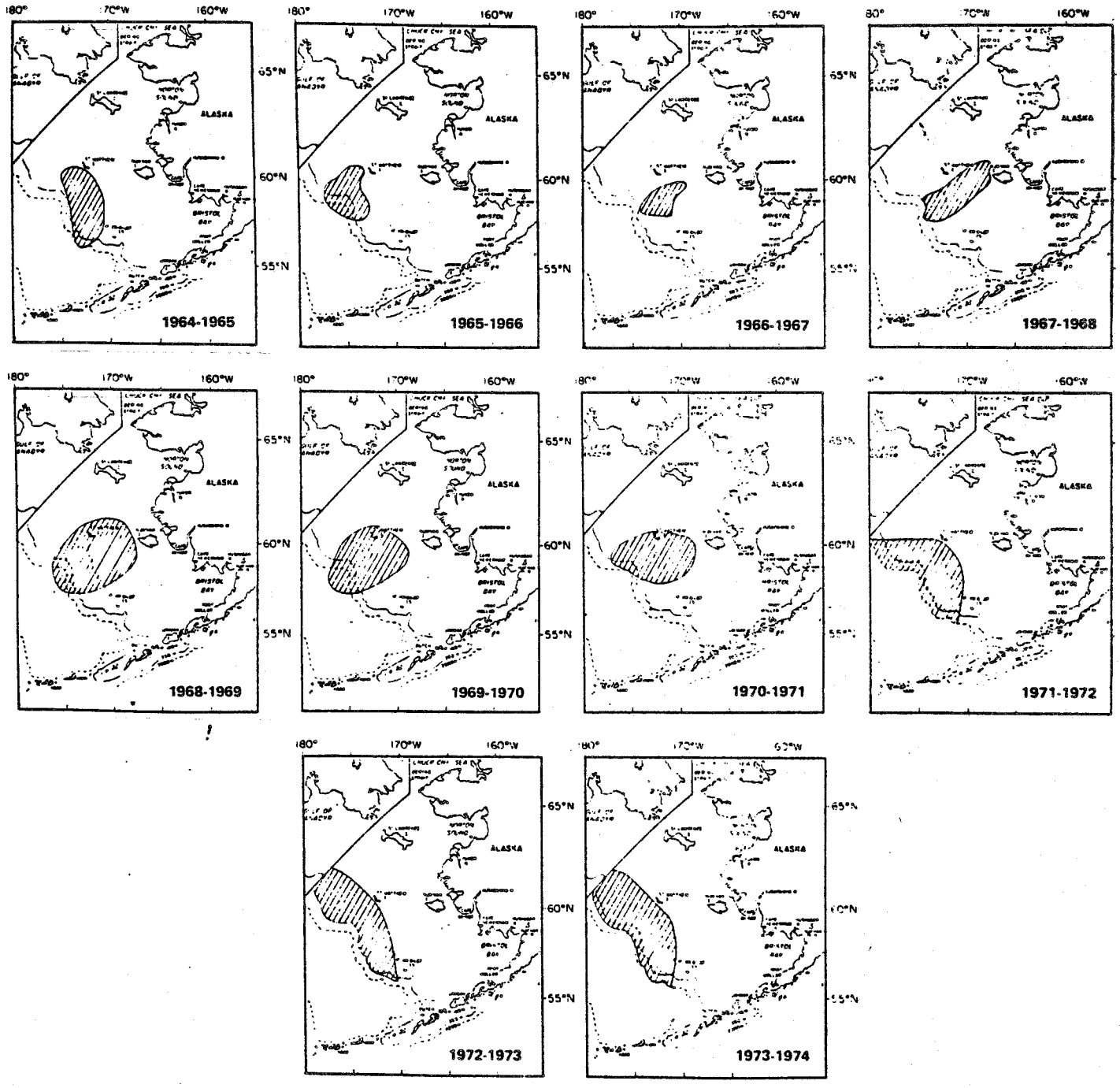

Figure 3-3. Location of Soviet herring fisheries in the eastern Bering Sea, 1964-65 to 1973-74 (from NMFS Enforcement and Surveillance Division Annual Reports 1965-74).

Japanese trawlers usually ranged between 12 and 25 (Table 3-5). Peak effort generally occured in January and effort was reduced in February in several years due to storms and drifting ice. In April of 1972 and 1973 trawl fisheries for roe herring were attempted, but in both years the fisheries were unsuccessful because of heavy ice packs.

After the early 1970's Soviet and Japanese herring trawl effort steadily decreased. In the 1974-75 season only 50 vessels fished in the Soviet fishery and the season ended in mid-February; in 1975-76 the fishery did not begin until February and employed only 39 vessels; and in 1976-77 no vessels were identified fishing exclusively for herring after catch quotas were introduced into the 1977 fishery (see Section 3.3.3). Japanese herring effort also diminished significantly, with only 11% of the 1974-75 trawl catch a result of directed effort (Table 3-6). These changes are believed to be partially due to increased effort for pollock as well as decreased herring abundance.

Following the closure of the western Bering Sea herring fishery in 1968, the Japanese longline-gillnet fleet began a herring gillnet fishery along the western Alaska coast. From 1968 to 1976 the Japanese gillnet fishery centered in Bristol Bay and Norton Sound (Figure 3-4). The fishery in Bristol Bay generally occurred in mid-May and in Norton Sound in late May to mid-June. Heavy pack ice or late ice-out prevented full development of the fishery in Norton Sound in 1971, 1972, 1975 and 1976. The peak numbers of vessels in the fishery were 24 in May of 1969 and 42 in June of the same year. The 1977 gillnet fishery was very limited due to the closure of the area east of 168°W and north of 58°N (see Section 4.2). Some effort was expended outside this area, but was abandoned after a short time due to low catch rates. In 1978 the area south of 58°N and east of 168°W was also closed to herring fishing, effectively terminating this fishery.

3.3.2 Vessels and gear employed

The Japanese trawl fishery consists of independent factory trawlers that both catch and process their own catch (Forrester et al. 1978). The processed products are transshipped to Japan by refrigerated transport. The independent

stern trawlers range in size from about 350 gross tons to over 5,000 gross tons. The smaller vessels are usually equipped with limited processing equipment, freezing units, and refrigerated holds. A medium-sized independent stern trawler is 1,500 gross tons, averages 70 to 82 m in length, carries up to 90 men and normally has a large processing area with modern machinery for washing, heading, gutting, and filleting the catch (Dickinson 1973). Plate freezers and refrigerated holds are standard equipment along with reduction plants for producing fish meal. The larger stern trawlers of 2,500 to over 5,000 gross tons range in length from 88 m to over 120 m and carry crews of from 90 to 135. These vessels have equipment for heading, gutting, filleting, skinning the catch and freezing facilities. Most have reduction plants for producing meal and oil and equipment for producing minced fish.

Two basic kinds of fishing vessels have been used by the Soviets: side trawlers and factory stern trawlers (Pruter 1976). Side trawlers of 265-700 gross tons were used in the early years of the fishery, but were replaced by stern trawlers in recent years.

The largest of the Soviet fishing vessels are the factory stern trawlers, the most common of which is the BMRT of 3,170 gross tons, 85 m in length, and carrying a crew of about 90 (Pruter 1976). The factory trawlers usually process and freeze their own catch. A new class of factory stern trawler, the RTM, has come into increasing use in recent years. They are somewhat smaller than the BMRT's, commonly being 2,657 gross tons and 82 m long, but have the advantage of a larger deck area aft for handling gear and fish.

Differences exist in the trawl gear used by Japanese and Soviet vessels. Soviet herring trawls are generally larger than Japanese trawls. U.S. observers report that the head and footrope length of Soviet trawls are approximately 80 m, while the Japanese average 30-35 m. Japanese trawls are reported to have a codend mesh size of 90 mm and Soviet herring trawls have smaller codend mesh sizes of 30 and 50 mm.

In the Japanese gillnet fishery the vessels used were 25 to 52 m long and 70 to 500 gross tons with crews of 19 to 30 (Dickinson 1973). The vessels were equipped with freezers and refrigerated holds. Some vessels converted to

longline gear after herring gillnet fishing and remained on the fishing grounds from two to four months until the maximum hold capacity of about 400 mt was reached, after which they returned to home ports (Law Enforcement Division 1974).

The basic Japanese unit of gillnet gear, called a "tan", is approximately 46 m long and 4.3 m deep with mesh sizes of approximately 57 mm. The Japanese gillnets were diving nets made of monofilament and were fished a few meters below the surface (Jim Branson, pers. comm).[1/] Varying numbers of tans were generally joined together to form a string of gear.

3.3.3 Catch trends

Complete catch and effort statistics for herring taken by foreign fisheries in the eastern Bering Sea have not been available throughout the history of the fishery.

Beginning in 1964, Japan has submitted detailed statistics for its fisheries to the United States and Canada through the International North Pacific Fisheries Commission (INPFC). The USSR began to report catch statistics to the United States through bilateral agreement in 1967. Earlier estimates are from U.S. surveillance or from Soviet publications.

Because of the lack of statistics from some nations and the irregular method of reporting, available catch data for foreign fisheries may not reflect actual exploitation.

The Soviets reported harvesting 10,000 mt in the 1959-60 fishery (Shaboneev 1965) (Table 3-7, Figure 3-5). By the 1963-64 season it was estimated that the catch had increased to about 38,000 mt for the season. The catch declined in the following years when the Soviets failed to locate herring concentrations.

1/ North Pacific Fishery Management Council, Anchorage, Alaska.

Table 3-7. Herring catches in metric tons of Japan and the U.S.S.R. in the eastern Bering Sea by fishing year for 1959-1982 and all nation catches by calendar year.

Fishing Year (April-March)	U.S.S.R.	Japan	Total Trawl	Gillnet Fishery Japan	U.S.	Fishing Year Total	Calendar Year	U.S.S.R.	Japan	U.S.	Total
1959-60	10,000		10,000			10,000	1960	10,000	403	--	10,403
1960-61	9,800		9,800			9,800	1961	9,800	772	--	10,572
1961-62	24,450		24,450			24,450	1962	24,450	313	--	24,763
1962-63	47,060		47,060			47,060	1963	47,060	0	--	47,060
1963-64	38,950		38,950			38,950	1964	38,950	862	18	39,830
1964-65	10,000	1,362	11,362		18	11,380	1965	10,000	896	0	10,896
1965-66	5,000	3,117	8,117		0	8,117	1966	5,000[1/]	3,385	0	8,385
1966-67	5,000[1/]	2,831	7,831		0	7,831	1967	5,000[1/]	2,714	122	7,831
1967-68	9,800	9,486	19,286	30	122	19,438	1968	22,255	38,367	83	60,705
1968-69	75,379	50,857	126,236	818	83	127,137	1969	94,491	34,946	45	129,482
1969-70	92,228	23,901	116,129	1,949	45	118,123					
1970-71	60,126	24,236	84,362	1,585	32	85,979	1970	117,202	28,345	32	145,579
1971-72	67,546	13,143	80,689	4,603	18	85,310	1971	23,000	23,130	18	46,148
1972-73	39,999	346	40,345	472	88	40,905	1972	54,000	6,458	88	60,546
1973-74	16,810	219	17,029	1,878	78	18,985	1973	34,361	1,913	78	36,352
1974-75	15,039	2,663	17,702	3,337	114	21,153	1974	19,800	5,635	114	25,549
1975-76	9,518	3,119	12,637	736	51	13,424	1975	14,201	1,814	51	16,066
1976-77	18,097	13,449	31,546	2,668	8	34,222	1976	16,812	13,815	8	30,635
1977-78	8,340	2,703	11,043	551	2,550	14,144	1977	13,145	5,592	2,550	21,287
1978-79	6,133	1,804	7,937	0	7,305	15,242	1978	6,663	2,320	7,305	16,288
1979-80	2,151	1,009	3,160	155	11,754	15,069	1979	5,718	1,078	11,754	18,550
							1980	368[2/]	42[2/]	26,700[3/]	27,110
							1981			18,291	18,291
							1982			27,836	27,836

1/ Estimated, believed near 65-66 level based on effort (see Table 4).

2/ Foreign harvest of herring prohibited after February 10, 1980.

3/ Includes 5,200 mt wasted (dumped) herring.

Sources:

USSR 1960-1964: ishing season (November-April) from Shaboneev (1965) and Rumyantsev and Darda (1970); 1968-1976 furnished by the USSR under provisions of the US-USSR fisheries agreements; 1977: data provided by the USSR under provisions of P.L. 94-265.

Japan 1960-1963: Forrester et al., 1978; 1964-1976: Fisheries Agency of Japan; 1977: data provided by Japan under provisions of P.L. 94-265.

U.S. Alaska Department of Fish and Game, excludes subsistence catches.

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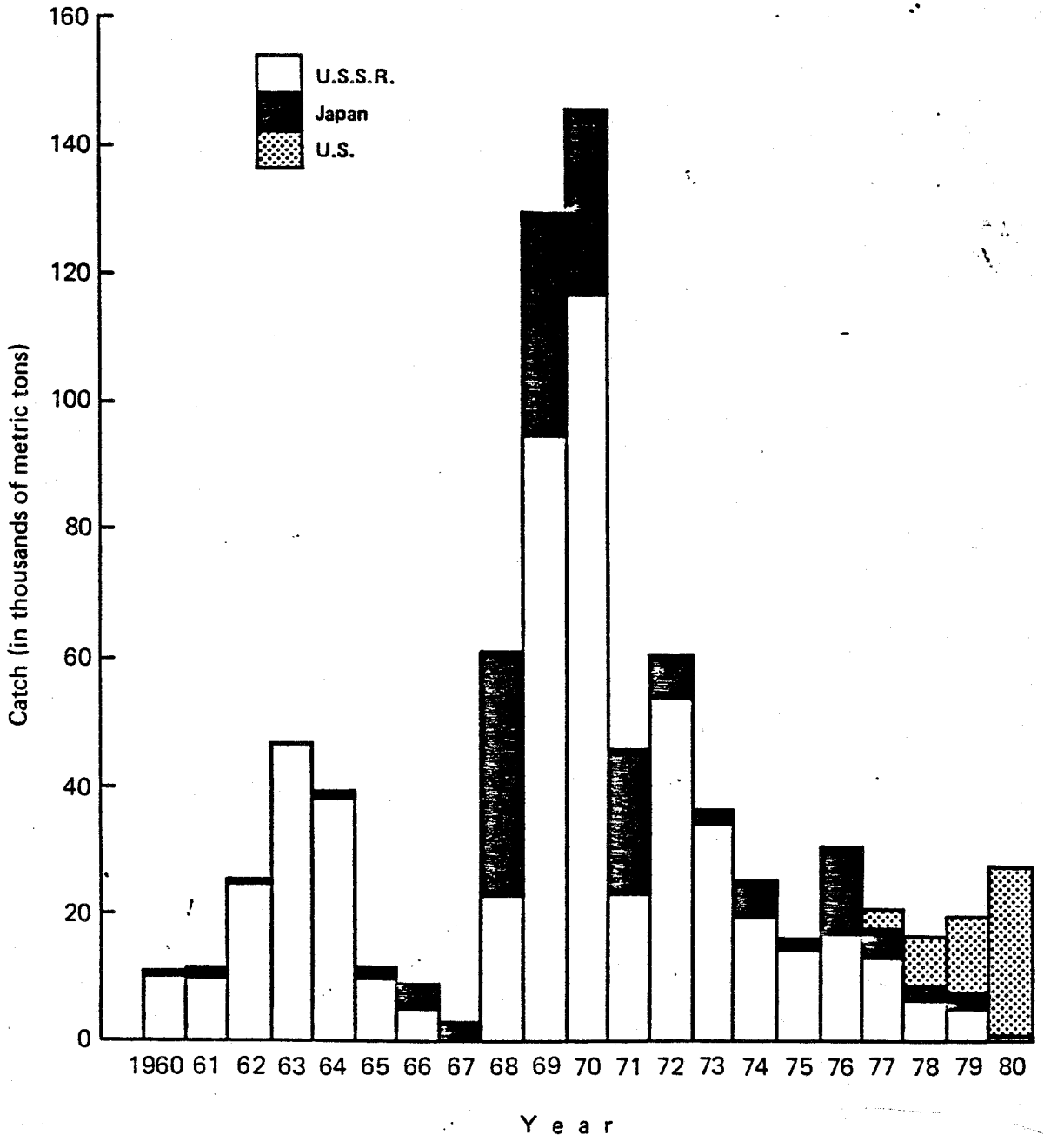

Figure 3-5. All nation eastern Bering Sea herring catch, 1960-80.

In the late 1960's catches increased as Soviet effort increased and the Japanese fisheries began targetting on herring. In 1970 (calendar year), the combined eastern Bering Sea herring harvest peaked at approximately 146,000 mt and then began to decline. Catches declined steadily until 1976 when a low catch of 16,066 mt was reported. The establishment of catch quotas within the US 200-mile zone and the restriction of the gillnet fishery reduced foreign catches to approximately 19,000 mt in 1977, 9,000 mt in 1978, and 7,000 mt in 1979.

The Japanese gillnet fishery harvested 30 mt in 1967, the first year of the eastern Bering Sea gillnet operations. Catches rose until 1971 when the catch was 4,603 mt (Table 3-7). From 1972 to 1977 catches fluctuated and did not show any trend; however, low catches appeared to occur in years of late ice recession.

4.0 HISTORY OF MANAGEMENT

4.1 Domestic

Herring fishery regulations affecting U.S. Residents were established by the U.S. Bureau of Commercial Fisheries (BCF) prior to 1959 and since then by the State of Alaska. The BCF was responsible for both research and management of domestic fisheries in Alaska before statehood.

4.1.1 Pre-Statehood (prior to 1959)

Federal regulation of the domestic herring fishery in the Bering Sea was minimal during the 30 years preceding Alaska statehood. Prior to 1923, there were no regulations applied to herring fisheries. Although the language of early regulations covered all fisheries, they probably were intended to apply more specifically to the protection of salmon. The Alaska Fisheries Act, enacted in 1924, authorized the Secretary of Commerce to issue regulations including seasons and mesh sizes. In 1929, a season from July 1 to November 30 was established for the Aleutian Islands (Bower, 1919-41). Traps were prohibited statewide, a minimum mesh size was established for gillnets and the obstruction of bays or lagoons was declared illegal. In 1930, regulations were established that prohibited the use of gear other than gillnets. The 1931 issue of Pacific Fisherman Yearbook states that this regulation was intended to discourage the establishment of reduction fisheries. After 1930 there were no major regulations that applied specifically to Bering Sea herring.

4.1.2 Post-Statehood (1959 to present)

In 1959, Alaska achieved statehood and, following a one-year transition period, assumed management authority over the fish and wildlife resources of the state. Regulatory authority was vested in the Alaska Board of Fish and Game; management responsibility was assigned to the Alaska Department of Fish and Game and enforcement to the Division of Fish and Wildlife.

Prior to 1978 regulations affecting commercial herring fishing were minimal as there were no area, season or catch restrictions for the Bering Sea. Regulatory measures have evolved in the face of the development of the commercial fishery with its increased effort and capacity for harvesting the resource. The current fishery is managed primarily by fishing seasons, specification of type and quantity of gear, district registration, and harvest levels. A significant facet of the Bering Sea Coastal herring fishery is the local dependence on herring as a subsistence food source. Under State law subsistence use of fish and game is accorded the highest priority over all other beneficial uses. Fishing regulations vary somewhat between major fishing areas to reflect local biological conditions and fleet characteristics. The regulations are published annually in the Alaska Finfish Commercial Fishing Regulations. The 1983-84 major regulations are summarized in Table 4-1.

In addition, buyers are required to keep records of each purchase and show the number and name of the vessel, the State license number of the vessel, date of landing, pounds purchased of each species, statistical area in which the fish were caught, and the type of gear used in taking the fish. State law also prohibits the waste of carcasses from commercially taken herring. "Waste" is defined as the failure to use the flesh for reduction to meal, production of fish food, human consumption, food for domestic animals, scientific or educational purposes or round herring bait. This eliminated the formerly used techniques of deliberately permitting decomposition of the herring carcass to permit removal and sale of the roe products.

4.2 Foreign

A number of regulatory measures affecting herring and groundfish fisheries have been implemented through public laws and international agreements prior to enactment of the Magnuson Act.

U.S. Public Law 88-308, enacted in May 1964, made it unlawful for foreign vessels to fish within the 3-mile territorial waters of the United States or to fish for designated fishery resources of the adjacent U.S. Continental Shelf. In October 1966, U.S. Public Law 89-658 established a 9-mile contiguous fishery zone adjacent to the U.S. 3-mile territorial Sea. The law

Table 4-1. 1983-84 major State of Alaska regulations for Bering/Chukchi Sea herring fishing.

MANAGEMENT AREA	FISHING SEASONS	HARVEST STRATEGY	LEGAL GEAR	REGISTRATION STATUS	OTHER
Statistical Area M (Aleutian Islands Area)	Apr 15 - Feb 28	harvest not to exceed 3,200 mt	seines, gillnets	non-exclusive	
Statistical Area N (North Peninsula Area)	Apr 15 - July 15 (sac roe season) Aug 15 - Feb (food/bait season)	none	seines, gillnets (trawls legal in Amak district only)	non-exclusive	North of 55°47'N. lat. trawls may be used by E.O. opening only.
Statistical Area T (Bristol Bay Area)	Apr 25 - June 30	guideline harvest level 20,000-40,000 mt	seines, gillnets	non-exclusive	Trawls may be used only during seasons opened by E.O.
Statistical Area W (Security Cove Area)	May 1 - June 30	guideline harvest levels Security Cove 750 mt; Goodnews Bay 300 mt	gillnets	non-exclusive	Trawls may be used only during seasons opened by E.O.
Statistical Area O (Cape Romanzof, Norton Sound, Kotzebue Sound)	Apr 15 - July 31 except Port Clarence and Kotzebue districts Apr 15 - Nov 15	guideline harvest levels Norton Sound, 3,000 mt; Port Clarence, 150 mt; Kotzebue Sound, 150 mt	Cape Romanzof- gillnet only Norton Sound, Port Clarence, Kotzebue - gillnet, seines	Cape Romanzof and Norton Sound are exclusive registration areas. Remainder of Area O non-exclusive	

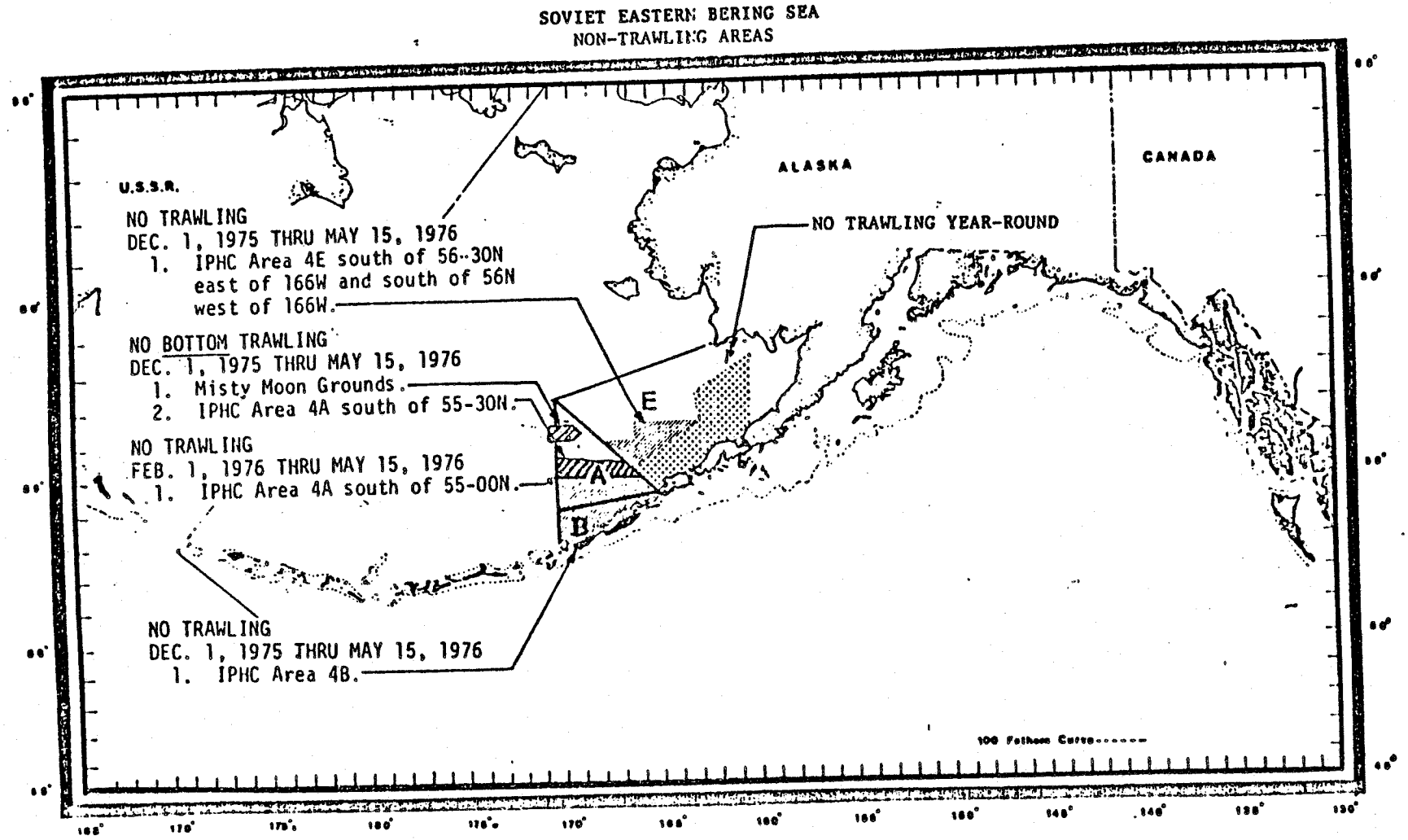

Figure 4-2. Area-time closures and restrictions for Soviet trawl fisheries in southeastern Bering Sea, effective through December 31, 1976.

Prepared November 28, 1975
National Marine Fisheries Service
Juneau, Alaska

Table 4-2. Comparison of catch quotas and reported catches in metric tons by calendar year for foreign fisheries in the eastern Bering Sea, 1973-1979.

	1973	1974	1975	1976	1977	1978	1979
Japanese Trawl							
Quota	33,000	33,000	15,000	15,000	5,800	2,580	2,413
Catch	385	2,298	1,078	3,760	5,041	2,320	
Japanese Gillnet							
Quota	4,600	4,600	3,000	3,000	1/	1/	1/
Catch	1,878	3,337	736	2,668	551	2/	198
USSR Trawl							
Quota	3/	3/	30,000	30,000	13,600	6,060	5,657
Catch	34,361	19,800	14,201	16,812	13,145	6,663	
ROK							
Quota						20	450
Catch						19	
Taiwan							
Quota						10	25
Catch						0	
Poland							
Quota							125
Catch							
Combined Fisheries							
Quota	3/	3/	48,000	48,000	19,400	8,670	8,670
Catch	36,274	25,435	16,015	23,240	18,737	8,983	198

1/ Combined with trawl fishing
2/ No effort
3/ Quotas not established

was then adjusted to 18,670 mt for 1978. A total of 8,670 mt (Japan 2,580 mt, USSR 6060 mt, ROK 20 mt, Taiwan 10 mt) was allocated to foreign fisheries in 1978 based on a projected domestic harvest of 10,000 mt. The foreign catch allocation in 1979 was identical to that for 1978 although the allocation by nation was slightly different: Japan 2,413 mt, USSR 5,657 mt, Taiwan 25 mt, Poland 125 mt, ROK 450 mt. The allocation for 1980 was withdrawn by court order on procedural grounds following court action by representatives of Western Alaska Native Villages against the Departments of Commerce and State. Herring was made a prohibited species. Under this FMP no directed foreign fishing for herring will be allowed, and only an incidental catch of herring in groundfish fisheries may be retained. Upon achievement of AIC herring becomes a prohibited species.

4.3 Effectiveness of Management Measures (Foreign and Domestic)

There is insufficient information regarding stock conditions or catch effort data to judge the effectiveness of management measures for the early domestic fisheries in the early 1900s.

A stock decline throughout the 1970s has apparently ceased and the stock appears to have increased during the last several years (Section 7.6). The effectiveness of management measures used to regulate the dominant foreign fishery, largely through catch restrictions, is unclear. Catch quotas imposed on the foreign fishery since 1973 may have the effect of discouraging fishing effort for herring in favor of other more abundant species. Actual catches made were considerably below quota levels during 1973-1976 (Table 4-2). A large-scale domestic commercial fishery has not existed long enough to adequately judge the effectiveness of management measures regulating this fishery.

5.0 HISTORY OF RESEARCH

Herring stocks have been extensively investigated in areas where they are commercially important (Cushing 1975). Research on Pacific herring has occurred primarily in Southeastern Alaska and British Columbia (Reid 1972, Taylor 1964). Much of the life history and population dynamics of Pacific herring have been developed for these areas. In contrast, research on herring in the Bering Sea has been limited, and most has occurred within the last three years.

5.1 United States Research

In the 1880's, exploratory surveys of the Bering Sea and western Alaska were begun by various departments of the Federal Government. These surveys, which continued into the early 20th Century, generally included a naturalist or fishery biologist who noted the occurrence of herring in the Bering Sea (Bean 1887, Cobb 1907, Gilbert 1895, Jordan and Gilbert 1899, Nelson 1887, Tanner 1890).

The first specific investigation of herring in the Bering Sea occurred in the late 1920's (Rounsefell 1930). Rounsefell collected samples from the catches from Unalaska and Golovin Bay in 1928, the year that commercial herring fisheries developed at Unalaska. The Bering Sea samples were included with samples from the Gulf of Alaska for investigation of the stock relationships of Alaska herring.

After 1928, there were no US herring investigations in the Bering Sea until the advent of the OCSEAP in 1975. There had been some sporadic sampling for biological statistics by the ADF&G in the 1960's and 1970's.

Intensive investigations of the distribution, relative abundance and biology of spawning stocks in addition to the determination of subsistence use levels were begun by ADF&G in 1975 under OCSEAP in an area from the Alaska Peninsula to Kotzebue Sound. Much of this research in addition to stock identification and biomass estimates of spawning fish is being continued by ADF&G through State and NPFMC funding. The NMFS, under OCSEAP, investigated herring in

Norton Sound and the Chukchi Sea and also reported on the occurrence of herring in southeastern Bering Sea demersal fish surveys (Wolotira et al. 1977, Pereyra et al. 1976). A winter hydro-acoustic survey was conducted in 1978 and 1979, northwest of the Pribilof Islands by NMFS to estimate the distribution and abundance of herring on the winter grounds.

In recent years, NMFS, first through the International North Pacific Fisheries Commission (INPFC), and later under the Magnuson Act, has placed observers on foreign vessels to monitor catch rates and to collect biological samples. ADF&G also had observers on domestic processors in the Togiak region since 1977 to collect biological data from the fishery.

5.2 Foreign Research

When the Soviet Union began fishing for herring in the eastern Bering Sea in the early 1960's, they initiated investigations to determine the extent and distribution of the herring resource. Most of the present knowledge of the offshore distribution and behavior of eastern Bering Sea herring is based on the Soviet research. Specific investigations dealt with winter abundance and distribution (Shaboneev 1965), summer abundance, distribution and migration (Rumyantsev and Darda 1970) and with eastern-western Bering Sea stock relationships (Prokhorov 1968). The main purpose of these surveys was the determination of the extent and potential uses of resources prior to commercial exploitation by the Soviet fleet.

Japanese research in the eastern Bering Sea began in the mid-1950's with limited exploratory trawl fishing. Extensive and systematic surveys of eastern Bering Sea groundfish by the Japanese were begun in 1963 by the Japan Fishery Agency (JFA), and have continued annually with the exception of 1972 (Japan Fishery Agency 1977). These surveys have covered broad areas of the continental shelf, and in some years included the shelf edge and upper continental slope. Japanese research efforts have focused on pollock and other demersal species; herring have only been noted incidentally.

The Japanese have been collecting catch and effort statistics and occasionally length frequency data from their herring fisheries since 1964. These data have been provided to the US through the INPFC.

5.3 Adequacy of Research

Research studies initiated by the U.S. during the late 1970's have contributed greatly to the general knowledge of distribution, relative abundance and biological characteristics of spawning herring in most coastal waters. In order to achieve fully the objectives listed in this plan, an expansion of studies is required on the following subjects: (1) accuracy of reported foreign catches; (2) estimates of current and future biomass; (3) origin and distribution of stocks; and (4) utilization and importance of herring in the diet of marine mammals, birds and fish. Sections 7.4 and 12.7 discuss these and other research concerns.

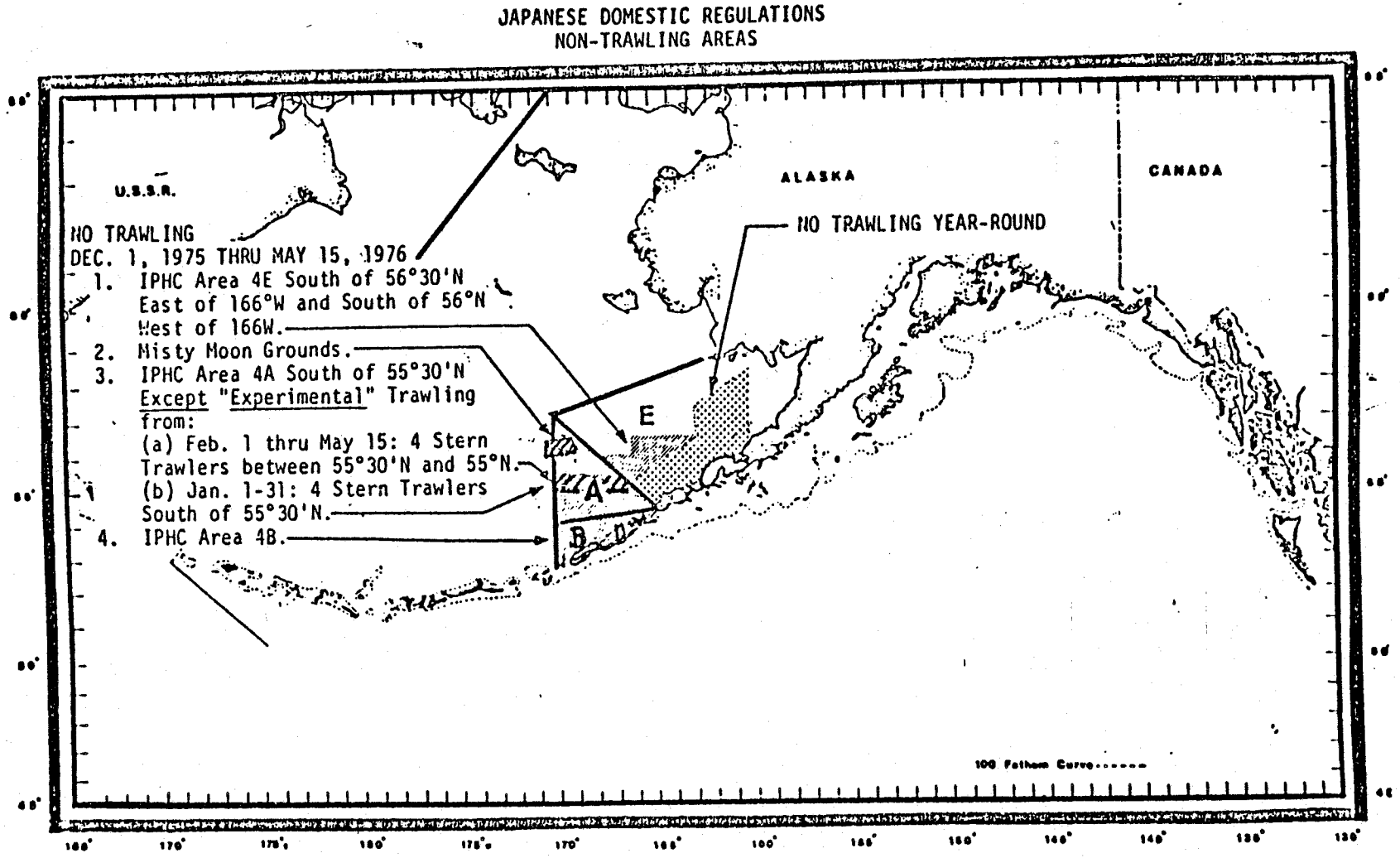

Figure 4-1. Area-time closures and restrictions for Japanese trawl fisheries in southeastern Bering Sea, effective through December 31, 1976.

Prepared November 28, 1975
National Marine Fisheries Service
Juneau, Alaska

provided that the United States would have the same jurisdiction over fisheries within this newly created zone as it had within its 3-mile territorial waters subject to the continuation of traditional fisheries by foreign nations.

Area-time closures for Japanese and Soviet trawl fisheries in the southeastern Bering Sea were established under bilateral agreements (Figures 4-1 & 4-2). These closures, designed to protect halibut stocks or to prevent gear conflicts between mobile foreign gear and fixed domestic gear, afford some protection to herring stocks as well.

Starting in 1973, bilateral agreements between the United States and Japan and the USSR established herring catch quotas for these nations in the eastern Bering Sea and Aleutian Island regions. Based on 1969 catch levels the Japanese trawl fishery had a quota of 33,000 mt in 1973 and 1974. This was subsequently reduced to 15,000 mt for 1975 and 1976. The Japanese gillnet fishery was restricted to a 4,600 mt quota in 1973-74, based on 1971 catch levels, and was further reduced to 3,000 mt in 1975 and 1976. The Soviet trawl fishery had a quota of 30,000 mt for 1975 and 1976. The purpose of these and subsequent catch quotas was to arrest the apparent decline in herring abundance and to prevent stock failure.

In 1977, foreign vessels were prohibited from fishing for herring in the Bering Sea east of 168°W. longitude and north of 58°N. latitude. This area was enlarged in 1978 when the 168°W. closure line was extended south from 58°N. to the Aleutian Islands. This closure was made to protect herring stocks important to U.S. coastal residents from Bristol Bay to Norton Sound and virtually eliminated the Japanese gillnet fishery.

Since U.S. extended jurisdiction, the foreign fishery has operated under sharply reduced catch quotas. In 1977, a total allowable catch of 20,400 mt in the eastern Bering Sea was established in the PMP (Table 4-2). Of this total, 19,400 mt (Japan 5,800 mt, USSR 13,600 mt) was allocated to the foreign fishery based on a projected domestic harvest (commercial and subsistence) of 1,000 mt. Due to an unanticipated commercial fishery in Bristol Bay, the allowable catch was exceeded by approximately 2,300 mt. The allowable catch

6.0 SOCIOECONOMIC PROFILE OF THE REGION[1/]

The inhabitants of the Bering Sea Coast are predominately Eskimo. The population is distributed among numerous villages of 100 to 500 inhabitants and a few regional centers of 1,500 to 3,000 residents. From south to north the regional centers are Dillingham, Bethel, Nome, and Kotzebue. These cities serve as transportation, communication, and administrative hubs of their respective geographical subregions. These regional centers have a sizeable non-native population in contrast to the rural villages, which typically have only a pair of white school teachers living year-round in the community.

Wage income is seasonal in rural Alaska, and opportunities for employment are few for villagers. Regular part-time wage income in the villages is earned by only a handful of residents who work as storekeeper, postmaster, health aid, teacher's aid, and school janitor. Cash income is earned intermittently from ivory carving, basket weaving, trapping, fire fighting, and construction work. Welfare payments from state and federal agencies are also sources of cash income. Most earned income in the villages is derived from the summer salmon fishery in which local people participate as fishermen and processing plant workers. In the Bristol Bay area the lucrative red salmon fishery has recently benefited from rising prices, sizeable runs, and the state program of limited entry. As a result, a few village participants in the Bristol Bay salmon fishery have recently earned incomes comparable to those of urban professionals. In the Kuskokwim, Lower Yukon, and Norton Sound areas, however, the commercial salmon fisheries are neither as large nor as profitable as in Bristol Bay, and generally the villages throughout the study area are quite poor. A recent socioeconomic study of Bristol Bay reported the median family income in that region was approximately $8,000 in 1970, in contrast with some $12,500 for the entire state.

In the Kuskokwim-Lower Yukon region, median family income is about half that of Bristol Bay.

1/ This entire subsection has been reprinted from The Social and Economic Impacts of a Commercial Herring Fishery on the Coastal Villages of the Arctic-Yukon-Kuskokwim Area, Hemming et.al., September 1978.

Subsistence activities - that is, the hunting of large and small game animals, sea mammals, and birds; the catching of fish; and the gathering of wild berries, greens, and eggs - play an important role in the economics of all of the villages in the study area. In fact, the rural economy is best described as a mixed cash/subsistence economy. It is generally thought that as the cash income of a village or of an individual increases, subsistence hunting and fishing decreases. Certainly Natives employed full-time in the regional centers cannot put up sizeable subsistence harvests. Also, construction work, fire fighting, and the other seasonal wage employment opportunities usually conflict, to some degree, with summertime subsistence activity. Since earning cash limits opportunities to hunt and fish, participation in the cash economy tends to be self-perpetuating. Typically, Native communities with the greatest opportunity for cash incomes, such as those close to rich fisheries, participate more fully in the modern cash economy in all respects than do villages without such opportunities.

Nonetheless, the social, cultural, and economic importance of subsistence activities to rural Eskimos is still so profound that it continues to coexist and often thrives with the conventional cash economy. Indeed, most subsistence hunting, fishing, and gathering involves significant cash outlays - for boats, motors, nets, snowmobiles, rifles, ammunition, fuel and lubricants, and other supplies. A recent study of subsistence activity in the Lower Yukon village of Kotlik, for example, has shown that households with the largest cash incomes harvest the greatest amount of traditional food.

7.0 BIOLOGICAL AND ENVIRONMENTAL CHARACTERISTICS OF THE FISHERY

7.1 Life History Features

7.1.1 General distribution

The Pacific herring (Clupea harengus) is found along the North American coast from Baja California to Cape Bathurst in the Beaufort Sea. The Asiatic distribution is from the Lena River in the Arctic Ocean, south to the Sea of Okhotsk and Korea (Hart 1973) (Figure 7-1). British Columbia is the southern limit of major commercial stocks in North America. Abundance south of British Columbia is low and commercial quantities occur only in limited areas (e.g. Puget Sound and San Francisco and Tomales Bays).

Within the Bering Sea, herring are found in both the eastern and western portions. In the western Bering Sea, herring occur all along the Kamchatka Peninsula, in the Olytorsky Gulf and north into the Gulf of Anadyr (Andriyashev 1954). In the eastern Bering Sea, herring occur from Unalaska Island to Port Clarence on the Seward Peninsula. Herring distribution is continuous into the Chukchi Sea and Arctic Ocean from the eastern Bering Sea. Herring distribution may also be continuous through the Aleutian Island chain as spawning herring have been observed at Adak Island and Japanese catches have been recorded in the western Aleutians.

Bering Sea herring are found on the continental shelf and slope and do not move into the deepwater of the Bering Sea basin. In the winter, generally, herring concentrate on the continental slope to avoid the shallower, colder waters of the shelf (Rumyantsen and Darda 1970).

The major wintering area of eastern Bering Sea herring is located northwest of the Pribilof Islands, approximately between 57° and 59° N. lat. in an area of 500-900 square miles (Shaboneev 1965). The location of herring on the winter grounds shifts in relation to the severity of winter and data also indicate considerable numbers of herring may be found under the ice fields further north (Figure 7-2). While on the winter grounds, dense schools of herring are found during the day a few meters off the bottom at depths of 105-137 m and at

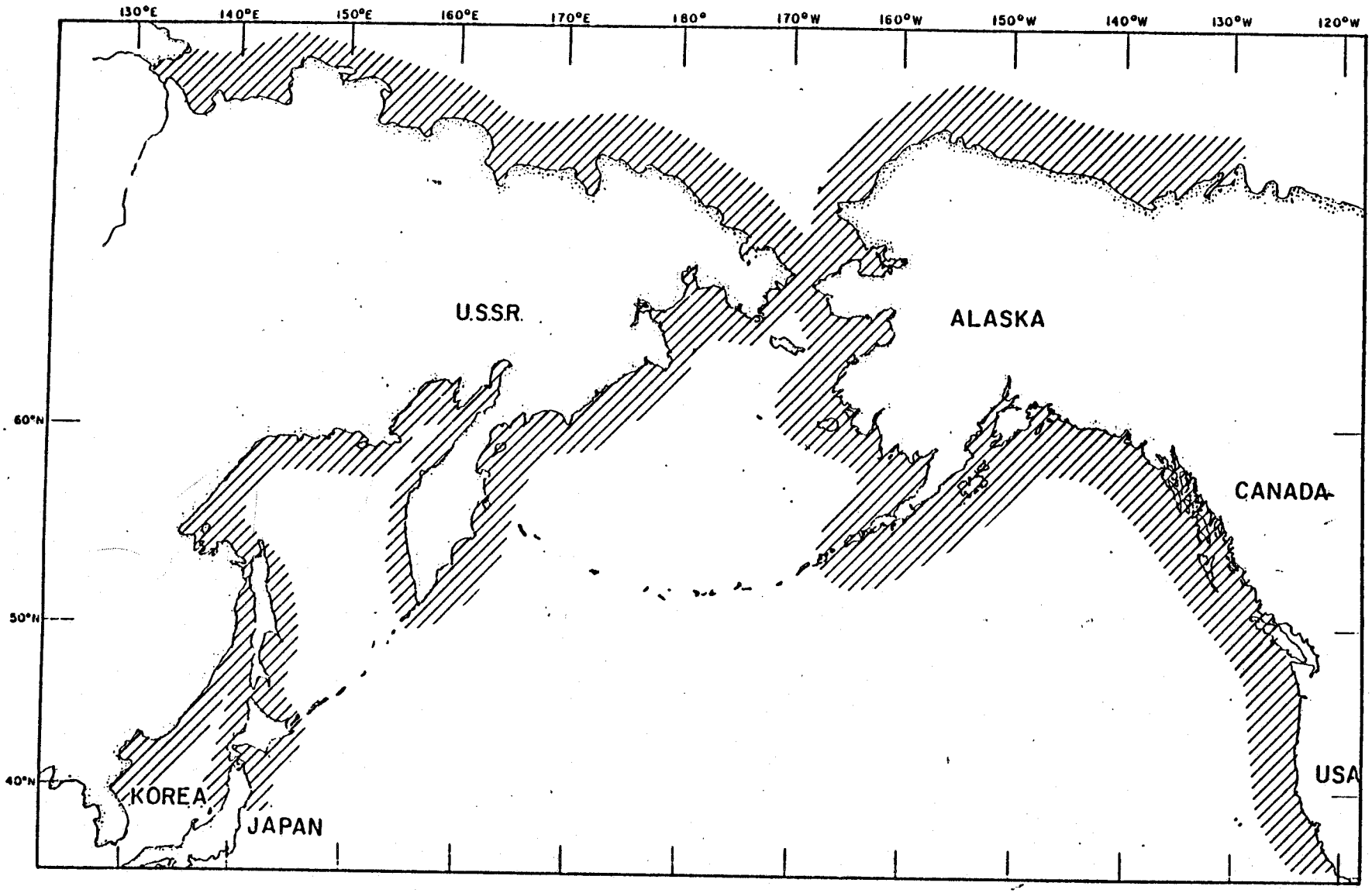

Figure 7-1. Geographic range of the Pacific herring (Clupea harengus pallasi) in coastal waters.

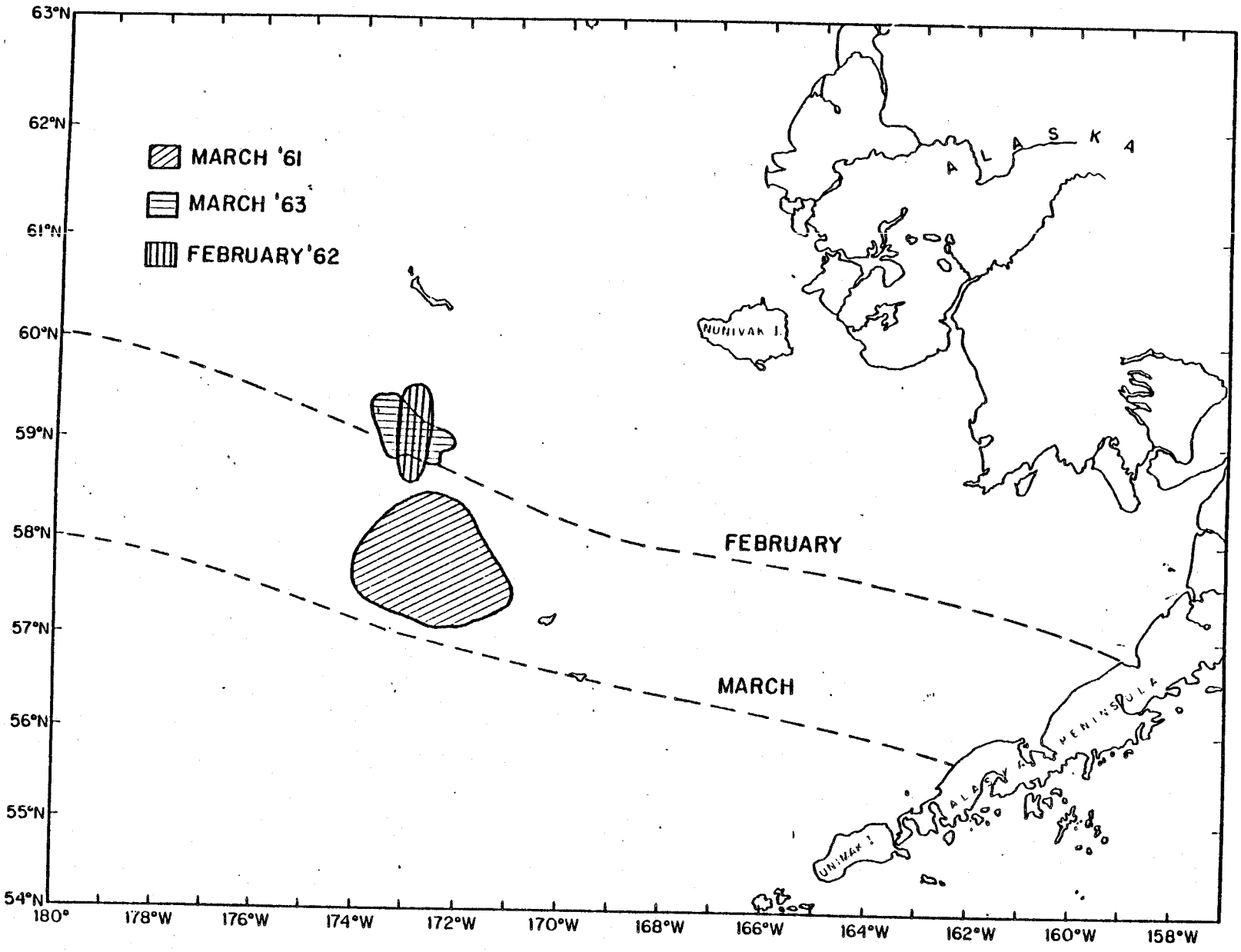

Figure 7-2. Location of herring on winter grounds in 1961-1963 and the approximate terminus of the ice in February and March.

water temperatures of 2-3.5°C (Dudnik and Usol'tsev 1964). During this period herring have distinct diurnal vertical migrations.

7.1.2 Migration and seasonal distribution

According to Rumyantsev and Darda (1970), herring leave the wintering grounds in late March and migrate northeast and southeast toward coastal spawning areas (Figure 7-3). Soviet surveys in the mid 1960's failed to locate herring concentrations on the Bering Sea slope or shelf in the summer and concluded that most herring apparently remain inside the 20-mile coastal zone after spawning. Trawl surveys covering much of the continental shelf of the eastern Bering Sea in August-October 1975 supports the Soviet observations as very few herring were taken in the survey (Pereyra, et al. 1976). Since some herring were taken in offshore waters, it is possible that herring may be unavailable to trawls during the summer because they are widely scattered or highly mobile.

In August, herring begin to migrate back toward the winter grounds coming first from the Nunivak and Unimak Island areas. The migration continues through September, and by October herring begin to concentrate on their winter grounds. Mature herring were found to reach the wintering grounds prior to the arrival of immature fish (Rumyantsev and Darda 1970).

Temperature seems to be the major factor influencing the seasonal distribution of herring in the Bering Sea. Soviet surveys found herring concentrated in deeper water on the continental slope during the winter months in 2-4°C water (Figure 7-4). Very few herring were found in the colder water prevalent on the continental shelf. In the spring herring were found to move through and tolerate subzero water temperature on the way to the spawning grounds. During the summer months herring were found on the shelf in the warmer, upper layers of the water column. Some differences were noted in depth distribution between maturity stages and ages which may have been influenced by temperature. In August herring began migrating toward the slope and were generally found in 2-4°C water.

Salinity may also influence herring distribution. A conclusive relationship has not been established, although there appears to be an age-salinity

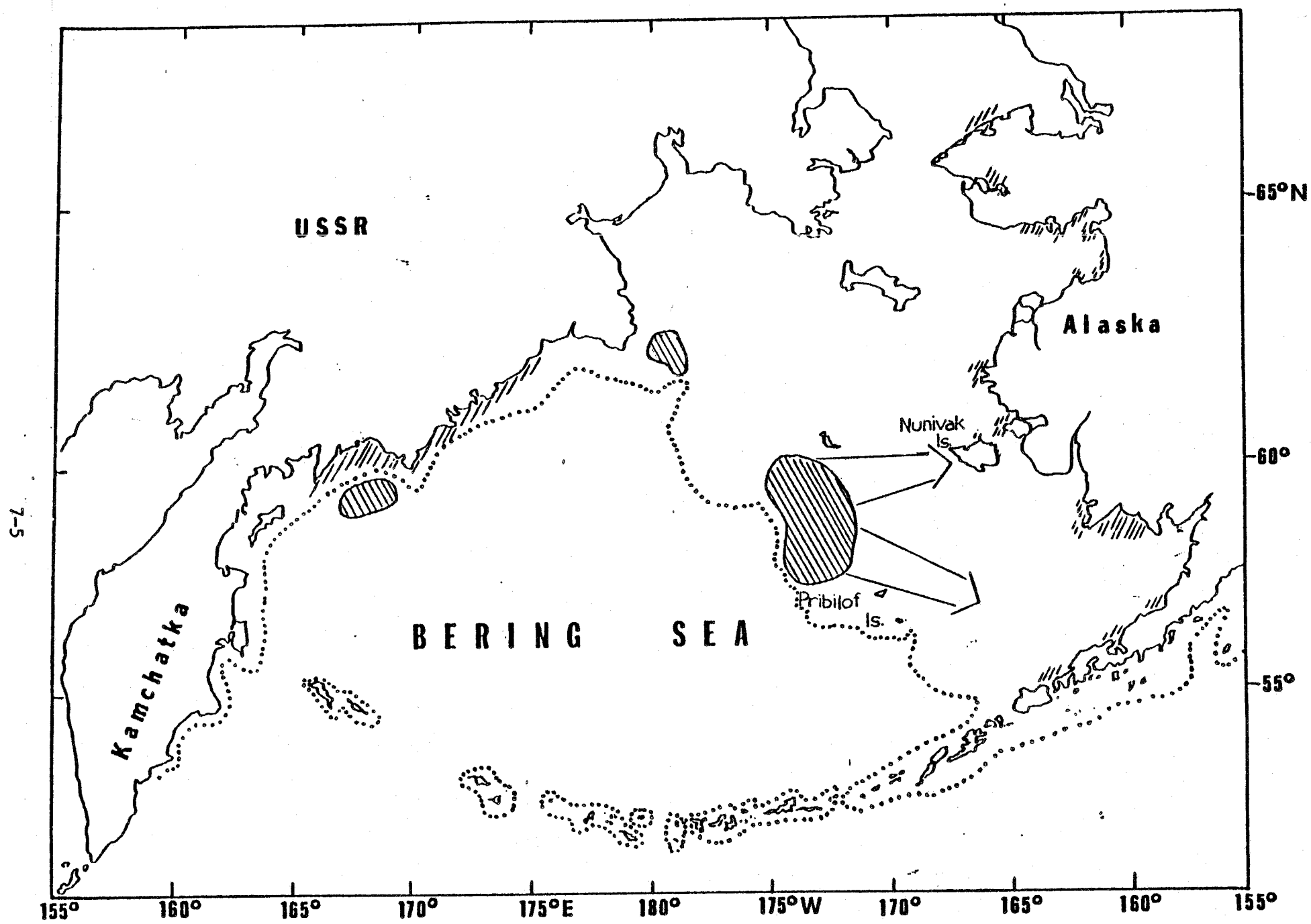

Figure 7-3. Location of the spawning and winter grounds (oval areas) of main eastern and western Bering Sea herring stocks and routes of migration of eastern stocks to spawning areas.

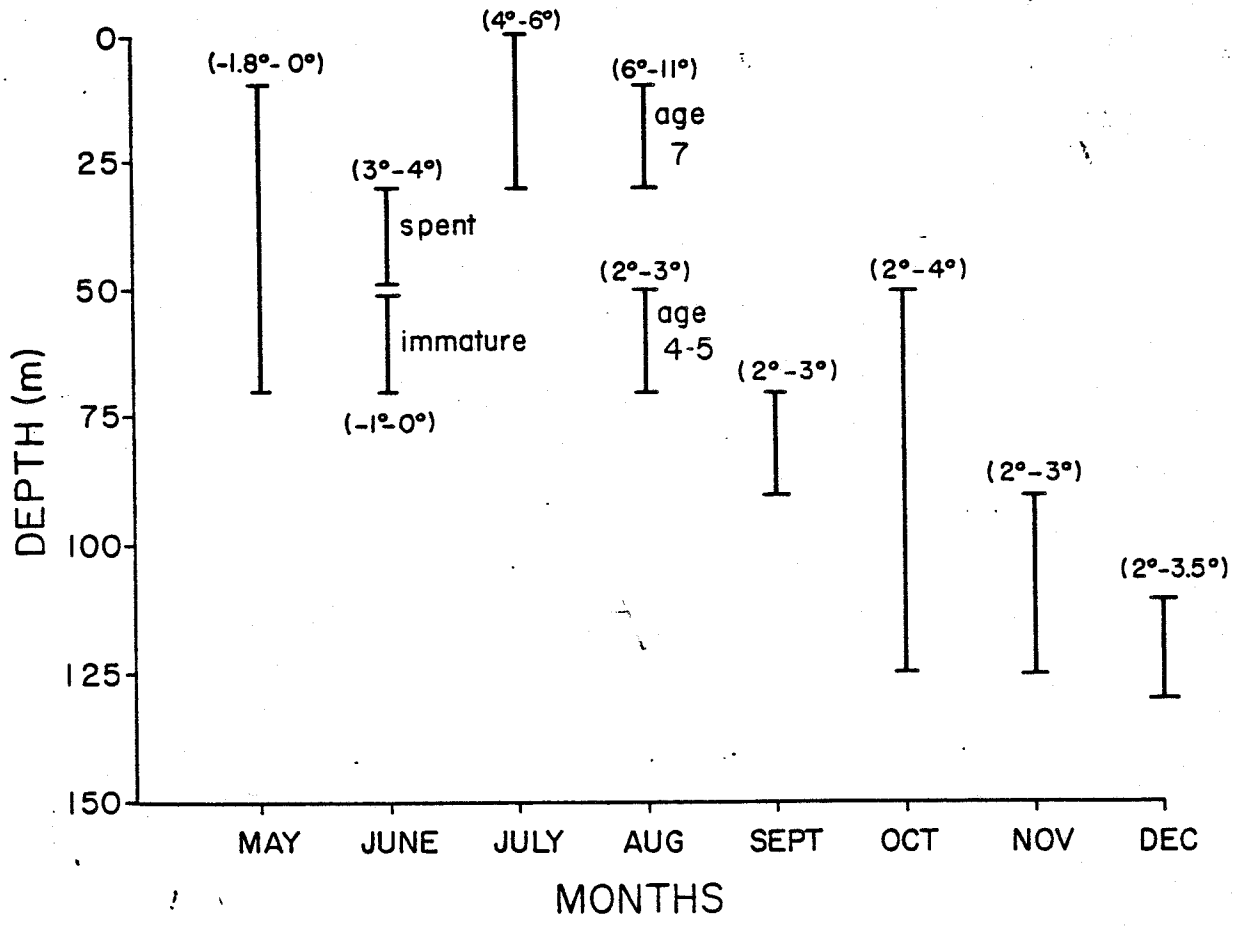

Figure 7-4. Monthly distribution of herring by depth and temperature (°C) in the eastern Bering Sea. May-November data from Rumyantsev and Darda (1970). December data from Saboneev (1965).

relationship (Taylor 1964). Figure 7-5 shows that there is a tendency for immature herring to occupy lower salinity water than adults.

Summer distribution in the eastern Bering Sea may also be influenced by the availability of food and heavy phytoplankton blooms (1-3 g/m^3) (Rumyantsev and Darda 1970). Rumyantsev and Darda concluded that herring remained in coastal waters during the summer because poor feeding conditions exist on the outer shelf and heavy phytoplankton blooms occur there. Herring captured on the outer shelf during the summer were in poor condition and had been feeding on items of low nutritional value--items other than their preferred zooplankton diet. Herring are believed to avoid the areas of heavy blooms because of the low nutritional value of phytoplankton and the gill settling properties of certain phytoplankton species which interfere with respiration (Henderson et al. 1936).

7.1.3 Spawning

Pacific herring spawning commences in January in the southern end of its range (California) and starts progressively later to the north (Scattergood et al. 1959). As shown in Figure 7-6, Bering Sea spawning generally begins in May in the Alaska Peninsula - Bristol Bay area and from June to mid-July in more northern areas. Spawning herring were believed to have been observed in Kotzebue Sound in mid-August (Barton 1978). Spawning has been noted to occur over a range of 6-10°C in the Togiak area (Warner and Shafford 1977). The duration of spawning may range from a few days to almost a month depending on location and year.

Herring deposit eggs on vegetation, primarily rockweed (*Fucus* sp.) and eelgrass (*Zostera* sp.) (Taylor 1964). Herring eggs are adhesive, measure approximately 1 mm in diameter, and one square inch of seaweed may be covered with up to 1,000 eggs in several layers (Outram and Humphreys 1974).

Herring generally spawn in sheltered bays and avoid exposed coastlines (Taylor 1964). Spawning in the North Pacific takes place near the shoreline between the high tide level and 11 meters (Hart 1973).

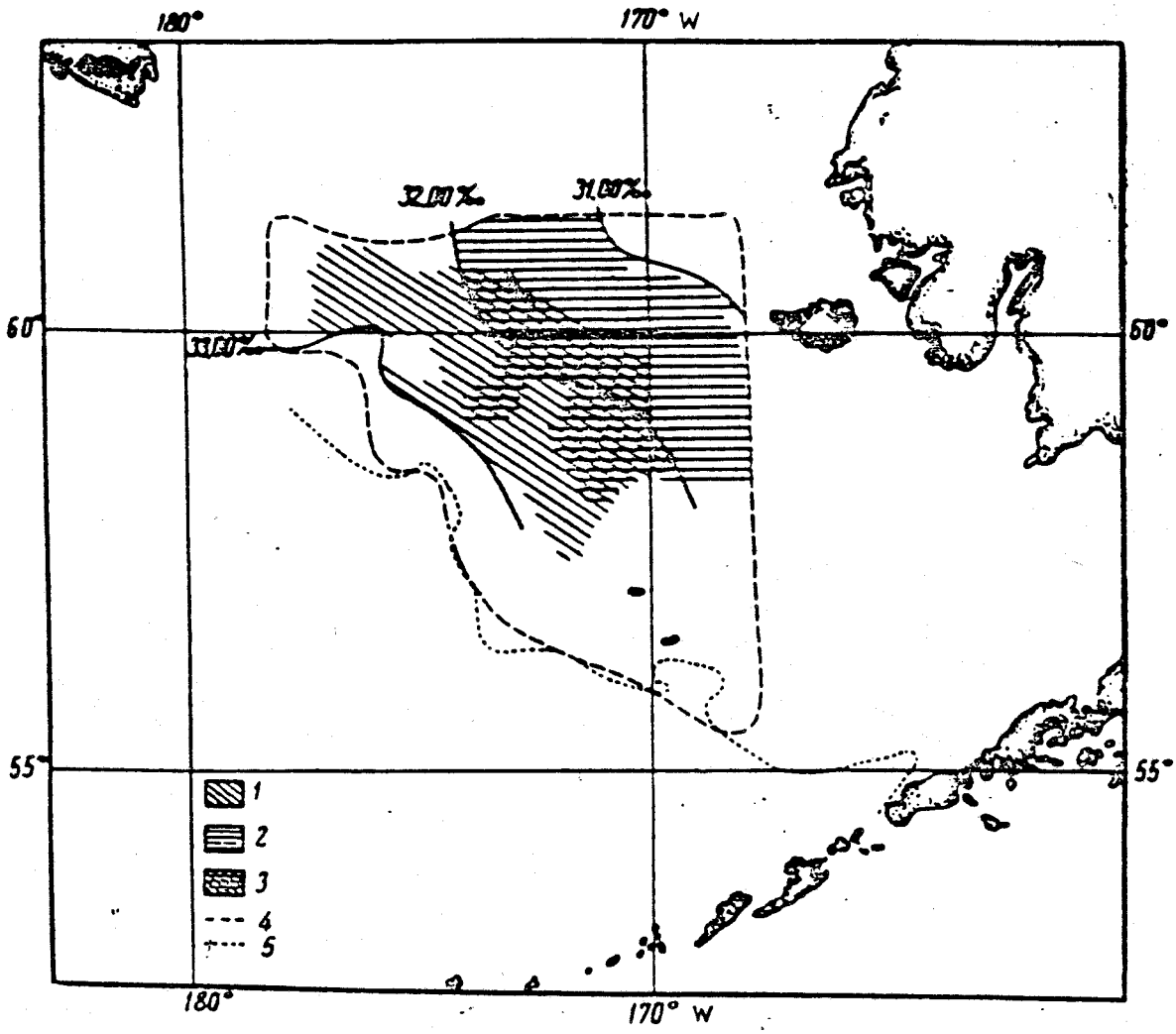

Figure 7-5. Distribution of herring in relation to salinity during October: 1 - mature; 2 - immature; 3 - mixed; 4 - investigated regions; 5 - 200-m isobath. (Rumyantsev and Darda, 1970)

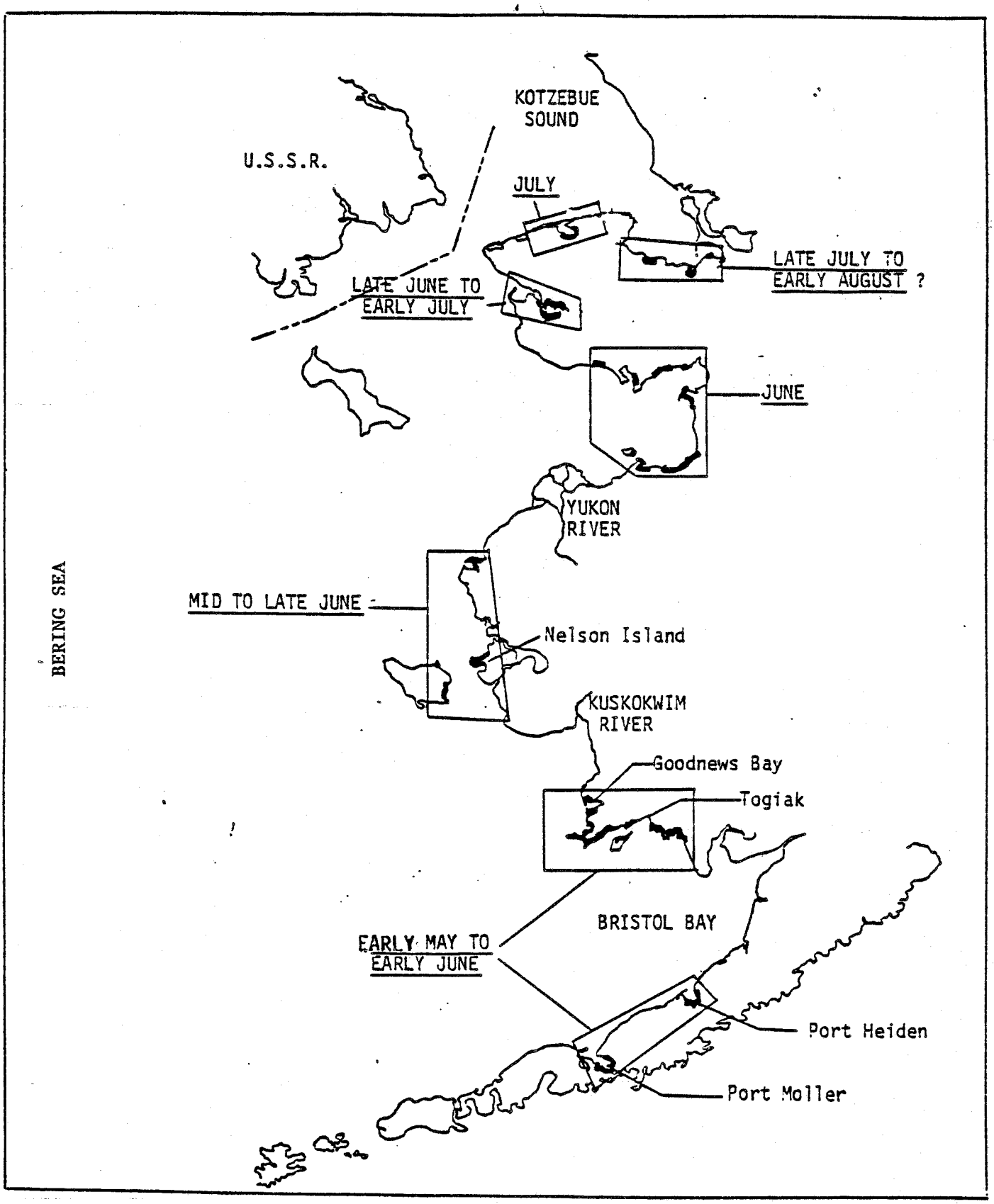

Figure 7-6. Timing and distribution of Pacific herring spawning in the eastern Bering Sea.

Barton (1978) reported that spawning grounds in western Alaska were of two basic types: exposed rocky headlands and shallow lagoons, inlets and bays. The first type characterizes spawning areas from Norton Sound to Bristol Bay and portions of Kotzebue Sound. In these areas spawning occurs in intertidal and shallow subtidal water with spawn being deposited primarily on rockweed. Most spawning on the Seward Peninsula occurs in shallow lagoons and bays where eelgrass is common. The bottom type is usually sand and/or mud and spawning usually occurs in shallow subtidal water less than two meters deep. Herring do not seem to utilize some substrates which in appearance are similar to nearby substrates on which spawn was deposited.

7.1.4 Larval and juvenile development

Eggs take 10-21 days to hatch depending on the water temperature. Alderdice and Velson (1971) suggested that optimum temperatures are 5-9°C for development and that 4-5°C is the lower thermal tolerance for herring eggs.

Herring hatch as larvae averaging 8 mm in size. The planktonic larval stage lasts for approximately 6-10 weeks at which time the larvae have grown to approximately 30 mm and begin to metamorphose into juveniles (Taylor 1964).

Upon completion of metamorphosis, juvenile herring are free swimming and begin to form schools. The schools enlarge and move out of the bays as summer progresses (Taylor 1964). Hourston (1959) found that juveniles moved from the spawning grounds on the northwest side of Barkley Sound, British Columbia, to rearing grounds on the southeast side. No specific reason could be found for this migration to the southeast other than that juveniles seem to prefer the calm, sheltered water there. Juveniles in Barkley Sound actively fed at depths of 0.6-5 m at dawn and dusk (Hourston 1959). No sampling was done at night but some inactive schools were observed near the surface. Hourston found juvenile schools in a range of salinities, but most were found at 25 0/00 salinity, which corresponds to Fujita and Kokudo's (1927) point of best fry survival. Herring in the northern Bering Sea and Chukchi Sea may have a much lower salinity tolerance as eggs and fry were found in Imuruk Basin near Port Clarence in water of 4 0/00 salinity (Barton 1978).

Little is known about the juvenile stage in the Bering/Chukchi Sea region from the time they leave the coast in their first summer until they are recruited to the adult population. Rumyantsev and Darda (1970) indicate that immature herring feed in coastal waters in summer and move to deeper water in winter. Juvenile herring in British Columbia and southern Alaskan waters winter offshore and reappear in bays the following summer (Taylor 1964; Rounsefell 1930). Prokhorov (1968) found that in the western Bering Sea ages 0 and 1 fish inhabit areas nearer shore and at lower temperatures than adults.

Barton (1978) found ages 0, 1 and 2 herring in the Port Clarence area in 1977. More than 50% of the juveniles were captured in Imuruk Basin, the brackish forebay of the Port Clarence/Grantley Harbor complex. He reported that juvenile herring were not captured in significant numbers until mid-August although some were present during the spawning period (late June-early July). He also stated juvenile herring were the most identifiable food item in stomachs of sheefish (Stenodus leucichthys nalma) that were captured in Hotham Inlet in November 1963.

Wolotira (1977) found both mature prespawning and immature herring in trawl catches made in the offshore waters of the northern Bering Sea and southern Chukchi Sea; however, age 0 herring were only found in the pelagic region of Norton Sound between Cape Douglas and Golovin Bay.

Substantial numbers of age 1 herring were captured in June, 1978, in Hagemeister Strait of northern Bristol Bay (Barton, 1979).

7.1.5 Maturation and fecundity

Bering Sea herring spawn for the first time at ages 2-6, but the majority do not spawn until ages 3 (50% mature) and 4 (78% mature). By age 5, 95% of the population has matured (Rumyantsev and Darda 1970). Sexual maturity of eastern Bering Sea herring coincides with recruitment into the fisheries, primarily at ages 3 and 4.

It appears that the onset of sexual maturity occurs earlier in the Pacific herring's southern range and progressively later proceeding northward. Stocks

south of the Bering Sea mature between ages 3 and 4 in British Columbia and ages 2 and 3 in California (Hart 1973, Rabin 1977).

Fecundity in mature herring varies as a function of body length and latitude, with larger and more northerly herring having higher fecundity (Nagasaki 1958). Herring fecundity appears higher in the eastern Bering Sea than in stocks in the Gulf of Alaska or western Bering Sea (Table 7-1).

7.1.6 Age and growth

Herring in the Bering Sea have been found to attain an age of up to 15 years (Barton 1978). Herring generally occur in fisheries in substantial numbers from ages 3 to 6, but, due to strong year classes, ages 7 to 10 may comprise a substantial portion of the catch (see also Section 7.6).

Herring stocks in the Bering Sea grow at about the same rate as stocks in the Gulf of Alaska and British Columbia until ages 3-4 (Figure 7-7). Compared to other stocks, growth is faster in the Bering Sea for older fish and they achieve a greater maximum length and weight than the more southern stocks (Table 7-2).

Hart (1973) reports 330 mm as the maximum length reported from British Columbia. Rounsefell (1930) reported many herring of 380 mm in the catch of Unalaska. In more recent investigations, Rumyantsev and Darda (1970) and Warner (1976) have found Bering Sea herring of 340-345 mm. Barton (1978) found that size-at-age in spawning aggregates along the western Alaska coast from Norton Sound north are significantly smaller than stocks to the south (Figure 7-8).

A general growth curve was derived for eastern Bering Sea herring by applying von Bertalanffy's equation to data reported by Shaboneev's 1965 data.

$$L_t = L_{oo} \ [1-e^{-k(t-t_o)}]$$

The parameters of von Bertalanffy's equation for eastern Bering Sea herring are: L_{oo} (maximum length in mm) = 314.5, K (growth rate) = 0.35 and t_o (age in years, fish was 0 length) = 0.0261.

Table 7-1. Fecundity (thousands of eggs) of northern Pacific herring.

Area / Age	4	5	6	7	8	Source
E. Bering Sea 1963	26.6	34.4	46.1	59.5	70.8	Shaboneev 1965
1964	26.6	32.1	52.4	53.5	77.8	Rumyantsev and Darda 1970
Alaska Peninsula 1976	$\bar{X}$=26.4	Range:	12.6-84.8		Ages IV-VI	Warner 1976
Karginskii Bay 1963		26.8	30.1	37.4		Kachina
W. Bering Sea 1964			39.2	43.3	50.6	"
Vancouver 1955	19.9	23.8	29.6	38.2	30.4	Nagasaki 1958

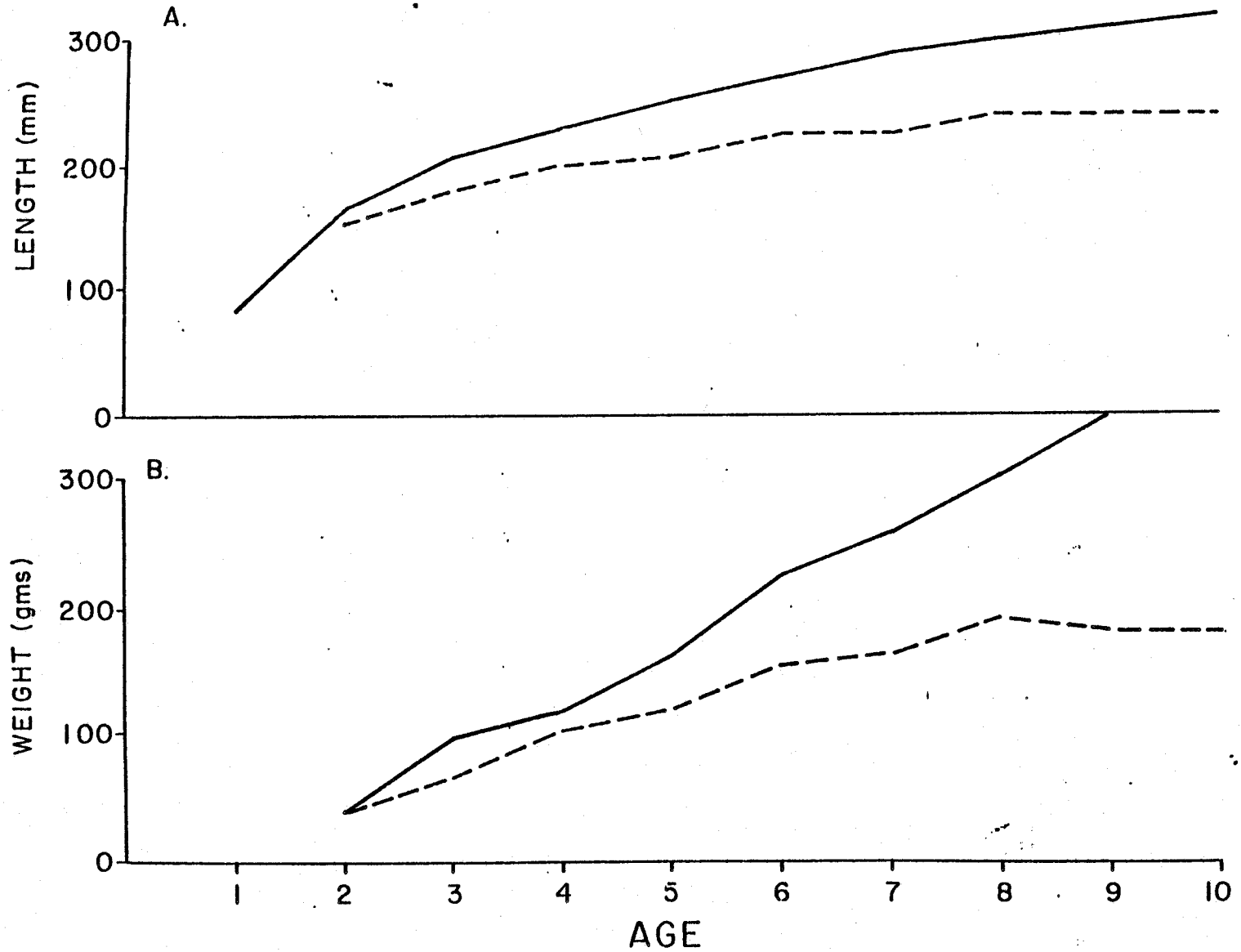

Figure 7-7. Comparison of growth in length (A) and growth in weight (B) of Gulf of Alaska (---) and eastern

Table 7-2. Standard length (mm) comparisons of herring from selected Bering Sea and Pacific Ocean areas.

Age Class	Port Clarence [1]	Eastern Norton Sound [1]	Yukon-Kuskokwim Delta [2]	Togiak [2]	North Alaska Peninsula [3]	Prince William Sound [4]	Southeast Alaska [4]	British Columbia [5]
0	90 [6]	50 [7]						
1	114	150			151			148
2	159	175		141	156		152	186
3	164	184	210	209	182	177	176	194
4	173	203	225	229	205	189	198	203
5	183	223	227	244	216	199	207	215
6	200	228	247	255	230	209	223	220
7	202	238	278	273	262	214	222	223
8	204	248	279	279	256	221	238	220
9	207	255	290	289	261	231	236	
10	211	258	263	286	265		237	
11	229	260		303		215		
12	228	275		306				
13	228			306				
14	244							
15	240			330				
Sample Size	834	822	101	4,257	1,198	417		

1/ Data from Barton 1978.
2/ Data from Barton et al. 1976.
3/ Data from Warner and Shafford 1977.
4/ Data from Fridgen, personal communication.
5/ Data from Randall 1975.
6/ Samples taken from September 29 to October 5, 1977.
7/ Samples taken on September 8, 1977.

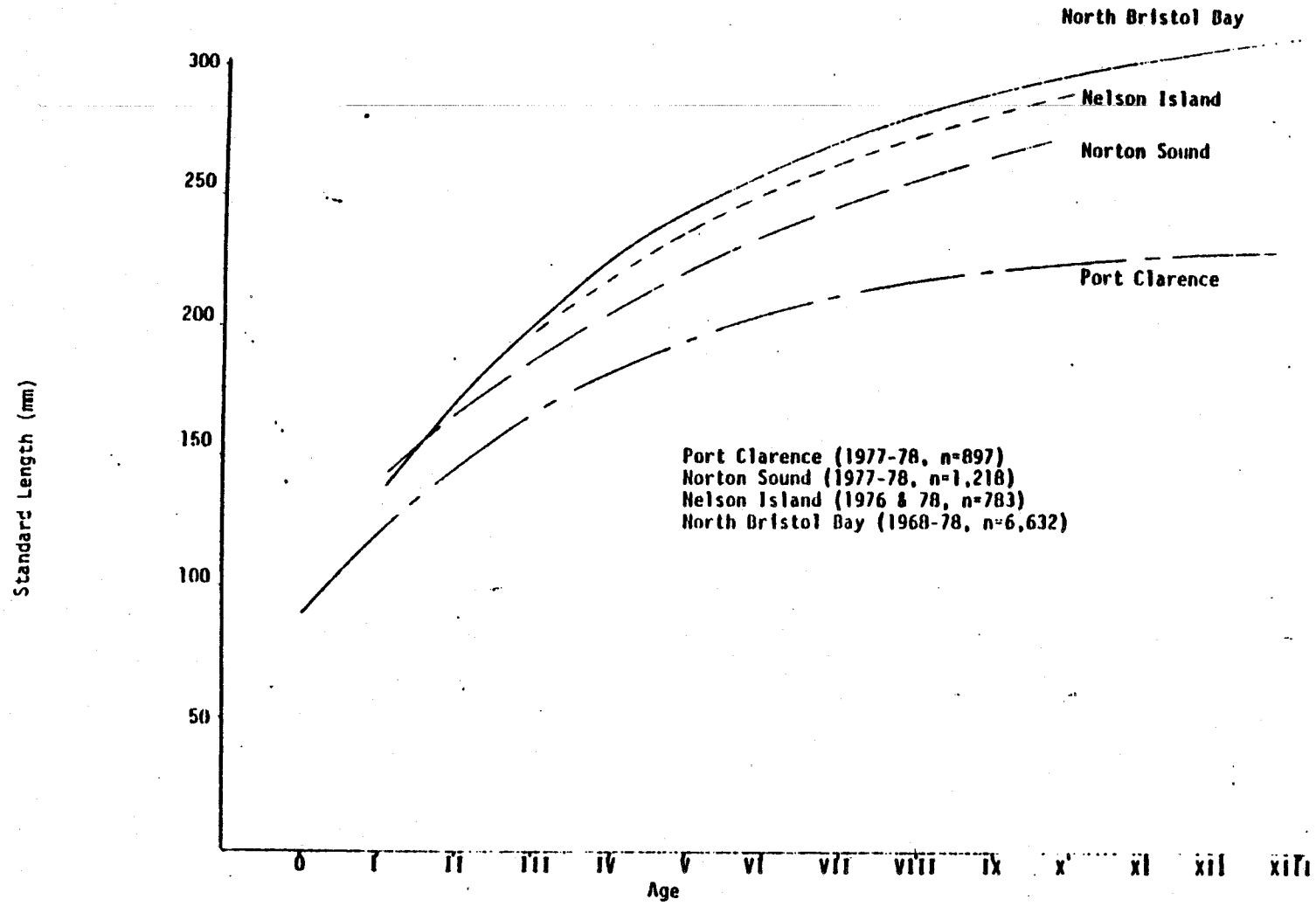

Figure 7-8. Size-at-age comparisons of Pacific herring from selected areas in the eastern Bering Sea. Lines are hand fitted.

Warner (1976) computed a Von Bertalanffy curve for fish captured in trawl samples in Bristol Bay. His coefficients were L_{oo} = 299, k = 0.18 and t_o = 2.10. These estimates, although lower, do not differ significantly from Shaboneev's data given the variances reported by Warner.

7.1.7 Food and feeding

The first food of larvae is limited to small and almost immobile plankton organisms that the larvae must nearly literally run into to notice and capture (Nikitinskaya 1958). Earliest food is sometimes more than 50% microscopic eggs, and other items include diatoms and young or nauplii of small copepods (Tester 1935).

Herring do not have a strong preference for certain food species, but feed on the comparatively large organisms that predominate in the plankton of a given area (Kaganovskii 1955).

In November-December in Kamchatka waters of the western Bering Sea, Kachina and Akimova (1972) found that juvenile herring consumed small and medium forms of zooplankton (Chaetognaths, copepods, tunicates) and benthoplankton (mysids). Euphausiids, amphipods, mollusks, and other organisms were found rarely and usually in small quantities. In the demersal zone, herring stomachs contained quantities of tubes of polychaete worms, bivalve mollusks, amphipods, copepods, juvenile fish, and detritus.

In the eastern Bering Sea, stomachs in August were 84% filled with euphausiids, 8% with fish fry, 6% with calaniods, and 2% with gammarids (Rumyantsev and Darda 1970). Fish fry in order of importance, were walleye pollock, smelt, capelin, and sandlance. In spring, food was mainly Themisto (Amphipoda) and Sagitta (Chaetognatha), and after spawning the main diet was euphausiids, Calanus, and Sagitta (Dudnik and Usol'tsev 1964).

Nearly 75% of herring stomachs examined in the spring of 1976 from Togiak to Norton Sound were either empty or contained only traces of food (Barton 1978).

Only 25% of the stomachs examined were at least 25% or more full of which only 3.4% were 100% full. Major food items were cladocerans, flatworms (Platyhelminthes), copepods and cirripeds.

7.1.8 Natural mortality

Mortality is heavy during embryonic development. Taylor (1964) found egg mortality in British Columbia to range from 55 to 99% and average 70-80%. The major causes of mortality were wave action, exposure to air, and bird predation. Bird predation was the largest source of egg mortality (30-55%), but was a constant mortality source and did not appear to influence relative year class abundance (Taylor 1964). The majority of deposited spawn and kelp in the upper intertidal region along the south shore of Cape Romanzov, in the Bering Sea, was destroyed or washed away during a severe storm in 1978 which indicates that wave action may be a serious limitation to herring productivity (Gilmer 1978).

Size of eggs, egg mass thickness, and the depth of deposition of the eggs all influence survival. Galkina (1971) found that the greater the abundance of spawning fish and the thicker the spawn, the higher the relative mortality of embryos as compared to mortality of embryos in scattered and thin spawns deposited by lesser numbers of spawners. British Columbia researchers believe that optimum egg deposition occurs when 3-4 layers of eggs are deposited.

During the larval stage herring are planktonic and also subject to high and variable mortality rates. An important source of mortality may be the failure to obtain proper food after yolk sac absorption and from the passive transport away from the coast by prevailing currents (Outrams and Humphreys 1974). Stevenson (1962) found that when larvae in Barkley Sound were transported to the open sea, few of the transported larvae survived. In British Columbia there are indications that the direction and magnitude of surface water transport determines larval survival. A net northward movement indicates that water is held against the coast, and a southward movement indicates that water is tending to be carried offshore. In general, onshore retention is associated with good year classes and offshore movement with poor year classes (Outram and Humphreys 1974).

Although temperatures and salinity were not considered important mortality factors in inshore areas, the great mortality of larvae offshore was suggested as possibly connected to the high salinity of the open sea (Stevenson 1962).

Juvenile mortality is more similar to adult mortality in magnitude and degree of variation than larval. However, in years of high egg and larval survival, juvenile mortality could be very high from intraspecies food competition.

Herring are preyed upon at all stages of their life cycle by a number of invertebrates, fishes, birds and mammals. Most predators have an opportunistic, non-selective diet and feed on the most conveniently available prey species. The importance of herring as a food item varies in the same areas in different months and years (Macy et al. 1978). Predation is more fully discussed in Section 7.5.3, especially concerning marine mammals, pollock and salmon.

Natural mortality data are unavailable for the eastern Bering Sea stocks. Natural mortality rates of .20 to .85 were estimated for herring stocks in southeastern Alaska and British Columbia (Skud 1963, Tester 1955). The rates in British Columbia were found to decrease from south to north and the rate for a given age in southeastern Alaska was lower than in British Columbia (Table 7-3).

To obtain an estimate of natural mortality for eastern Bering Sea herring, the procedure of Alverson and Carney (1975) was used. In this procedure the instantaneous rate of natural mortality (M) was obtained from:

$$T_{mb} = (1/k) \ln (M+3k)/M$$

where: T_{mb} = 0.25 the maximum observed age, or the time when a cohort's biomass is maximum.

k = the von Bertalanffy growth coefficient

ln = natural logarithm

Based on a maximum age of 15 years, as estimated from fishery data and a k of 0.265 (the mean of the two reported k values in Section 7.1.6), the natural mortality rate (m) for eastern Bering Sea herring was estimated to be 0.47.

Table 7-3. Instantaneous rate of natural mortality (M) for herring in the northeastern Pacific.

Area	/Age 3	4	5	6	7	8	Source
S. E. Alaska	.20	.33	.46	.59	.72	.85	Skud 1963
E. Vancouver Is.		.40	.64	.77	.85		Tester 1955
W. Vancouver Is.		.46	.61	.72	.79		"

Analysis of catch curves presented by Laevastu and Favorite (1977) using regression techniques (Ricker 1975) revealed the instantaneous mortality rate for fully recruited eastern Bering Sea herring to be 0.46.

7.2 Stock Units

Within the Bering Sea, three major herring wintering grounds have been identified. Prokhorov (1968) reported that in winter herring occur in mass concentrations northwest of the Pribilof Islands and in the Gulf of Olyutorski (Figure 7-3). Soviet scientists have also reported that stocks which spawn in the Gulf of Anadyr winter near Cape Navarin.[1/]

The pattern of herring migration between the coast and the outer continental shelf has effectively isolated Asian and North American herring in the Bering Sea. Prokhorov (1968) found that eastern and western Bering Sea herring had very different growth and maturation rates and dissimilar age structures. Similar differences are reported between herring wintering near Cape Navarin and those northwest of the Pribilof Islands, suggesting that although these groups are in close proximity there is little or no mixing between them.

Of the herring which winter near the Pribilof Islands, most are believed to spawn in Bristol Bay and in areas between the Yukon and Kuskokwim Rivers. This conclusion is based on Soviet research, similarities in age composition, and the distribution of Japanese trawl catches during the spawning migration (Wespestad 1978, Barton 1979). ADF&G aerial surveys indicate that the greatest abundance of spawning herring occurs in the Bristol Bay area and the smaller spawning aggregates occur to the north and south.

The relationship of herring spawning in Norton Sound to spawning stocks to the south is unclear. Norton Sound herring may migrate to the continental slope in winter, since herring appear in inshore waters in late May-early June (Barton 1978) and are genetically similar to spawning stocks to the south

1/ Report of U.S./U.S.S.R. scientific discussions. December 20-24, 1978, Northwest and Alaska Fisheries Center, NMFS, Unpublished.

(Grant 1979). However, it is possible that some or all herring remain in Norton Sound year-round. Barton (1978) relates that an autumn non-spawning run occurs in Golovin Bay in north Norton Sound, that herring occur in ring seal stomachs collected near Nome in November, and that herring have been caught through the ice by natives jigging for cod near Nome and in Golovin Bay.

North of Norton Sound, herring occur in Port Clarence, in inlets from the Bering Straits to Kotzebue Sound and in Kotzebue Sound. Barton (1978) believes that many, if not all, stocks of herring found north of Nome remain in the immediate area year-round and winter in coastal lagoons and brackish bays. He reports the occurence of herring during the winter months in several locations covered by ice (e.g. Port Clarence, Shishmaref and inner Kotzebue Sound).

Herring also occur along the Alaska Peninsula and through the Aleutian Islands. Marsh and Cobb (1911) reported that a large spawning occurred at Atka Island in 1910 and that spring and autumn runs occurred at Unalaska and Port Heiden. The fishery which operated at Unalaska in the 1930's and 1940's harvested herring in summer and early autumn, averaging 1,337 mt between 1929 to 1937. The current status of these stocks or their relationship to other eastern Bering Sea stocks is as yet unknown. Recent aerial surveys by ADF&G have found small spawning concentrations on the north shore of Unimak Island, in Heredeen Bay and in Port Heiden (Warner and Shafford 1977). The herring in these areas may winter in close proximity to the spawning grounds, as the continental shelf is immediately offshore. Data presented by Wespestad (1976) showing herring catches by Japanese trawlers just north of Unimak Pass in winter indicate that this may be the wintering area of herring spawning on the Alaska Peninsula.

Though much additional research must be performed before it will be possible to accurately describe the behavior of individual herring stocks in the eastern Bering Sea, it seems prudent to make the following tentative groupings based on similarities in distribution, behavior, utilization and abundance:

(1) Aleutian Island/Alaska Peninsula
(2) Bristol Bay/Goodnews Bay
(3) Kuskokwim/Yukon River delta
(4) Norton Sound
(5) Port Clarence/Kotzebue Sound

Aerial surveys conducted by the ADF&G during 1981-82 indicated that of these stock groupings, the Bristol/Goodnews Bay group accounted for 82-85% of the total spawning biomass. Conservative estimates of the spawning biomass as a percentage of the total, during 1982 were Bristol Bay/ Goodnews Bay -- 76% mt, Cape Romanzof -- 4%, and Norton Sound -- 14%.

Estimates are not available for the Aleutian Island/Alaska Peninsula groups nor the Port Clarence/Kotzebue Sound group. In both groups, the spawning biomass is reckoned to be small in comparison to the other groups.

Port Clarence/Kotzebue Sound stock groups are believed to move into the FCZ only during the summer feeding period and remain within 3 miles during the remainder of the year. For the Aleutian Island/Alaska Peninsula, it is estimated that some food and bait fishing will occur, and although biomass is unknown the performance of former fisheries indicates that yields of 1-2 thousand mt may be sustainable.

7.3 Data Sources

7.3.1 Catch and effort data

Catch and effort statistics are collected on a continuing basis from two main sources: from the commercial fishery and from research surveys. Commercial fishery data are used mainly to compute CPUE (Catch-per-unit-of-effort) trends to monitor the relative abundance of stocks under exploitation. In addition to CPUE computation, trawl survey information can also be used to estimate standing stocks. Commercial fishery data of sufficient detail and precision for stock assessment studies prior to 1977 are:

(1) Catch and effort statistics of the Japanese mothership, longline-gillnet, and North Pacific trawl and land-based trawl fisheries, as provided through INPFC;

(2) Catch and effort statistics collected by U.S. observers stationed aboard foreign vessels.

Since directed herring fishing by foreign nations will not be allowed under this FMP, catch and effort statistics will be available only from groundfish fisheries in the region.

Catch and effort statistics are also obtained from research trawl surveys conducted by NMFS, Japan Fisheries Association (JFA), and the International Pacific Halibut Commission (IPHC). The IPHC conducts an annual assessment of juvenile halibut abundance in the Bering Sea which provides catch and effort information concerning not only halibut but many other groundfish species as well.

Statistics from Japanese fishing operations have been among the most detailed and complete of any nation. In general, they are by species, 1/2° latitude by 1° longitude statistical areas, month, gear type, and vessel class.

Although somewhat improved after the early 1970's, statistics provided by the U.S.S.R generally reflected only gross catches of imprecise species groupings for very large statistical areas. Until the late 1970's, effort information was either lacking entirely or in a form that had little utility for assessing relative abundance (e.g., catch per tow without reference to tow duration). South Korea conducted a small herring fishery, but no statistics concerning it are available for the period prior to 1976 and those acquired after 1976 were incomplete. Herring operations by Taiwanese vessels were limited and no statistics were reported.

For status of stock evaluations, the catch and effort data bases generally relied upon have been those of the Japanese fisheries, and research surveys conducted by Japan, the United States, and IPHC.

ADF&G compiles statistics on domestic fisheries. Complete catch statistics are available from fish ticket (individual catch report) analysis. However,

effort data, which are also compiled, are presently available at a very gross level.

ADF&G has also monitored subsistence herring harvests and a fairly complete record of harvests has been compiled in recent years. An in-depth analysis of subsistence harvests was conducted by Hemming et al (1978) for the NPFMC.

7.3.2 Biological data

Biological data concerning herring are collected on a continuing basis from the commercial fishery and from research surveys. Those from the commercial fisheries have generally been limited to length-frequency samples from the Japanese fisheries until 1974 when the U.S. observer program was initiated. Very few offshore catch data have been available since herring was declared a prohibited species to foreign vessels in 1980. This has been almost entirely from reports of U.S. observers and foreign incidental catch reports. One objective of the observer program is to construct an extensive data base on length, weight, age and sex of the herring taken by foreign fisheries. Biological data are also obtained from domestic commercial fisheries by ADF&G research crews.

The most significant sources of biological data are the ADF&G surveys funded by the OCSEAP and published literature from the USSR fisheries investigations of the early and mid 1960's. These have provided the bulk of information on life history, abundance and distribution for Bering Sea herring.

7.4 Quality of Data

The quality of the data available for management of eastern Bering Sea herring is variable and dependent on the source of data. The major source of data until recently has been the herring fisheries of Japan and the USSR.

Data from the commercial fisheries should include the catch by species and the quality and quantity of effective effort expended to take this catch by relatively small geographical areas and time periods. In this way, trends in catch and standardized CPUE can be monitored by precise time-area units so

that reliable inferences may be drawn concerning stock abundance. In addition, biological sampling should be adequate to estimate size and age composition of the catch, by time and area. These basic fisheries data (catch, effective effort, age and size composition) provide much of the input for determining mortality rates, relative year class strength, changes in stock density, recruitment, and other population characteristics upon which the condition of stocks can be measured.

Japan had provided very detailed statistics for its fisheries, but even these are deficient in terms of fishing effort, age and size data, and completeness in reporting catches. Increases in vessel horsepower, improvements in fish detecting and harvesting gears, and experience acquired by the fishermen of the grounds have increased the fishing power of a unit of effort beyond that of previous years. These changes are difficult to quantify and complicate the analysis of catch-effort data. There is also the problem of determining what proportion of the total trawling effort was expended for herring. Biological data in the form of age or size composition of Japanese catches have been insufficient to non-existent.

The USSR has had a very poor history of reporting on its fisheries. There was virtually no breakdown of the catch by statistical areas that is useful in stock assessment nor were there data on the age and size composition of the catch.

The problem of inadequate detail of commercial fishery information has been partially solved as the U.S. observer program has expanded in scope to sample the foreign commercial catch. This program is also addressing the question of the accuracy and precision of reported catch data. The observer provides a source of catch, effort, and biological data and will be a major source of information as observer coverage increases.

The quality of data obtained from domestic fisheries is good in relation to quantity, time, and distribution of catches. Also, very good biological data have been obtained through the placement of catch samplers on processing vessels. However, detailed catch per unit effort data are not available for domestic fisheries, nor are there means of determining the incidence of fishes other than herring in the catches of individual vessels.

The overall quality of domestic research data is fair to poor. In coastal areas, recent intensive surveys have helped to define features of spawning behavior, relative abundance and coastwise distribution. The data on early life history, which may be a period when year class strength could be assessed, are very weak. Individual spawning stocks have been identified along the coast, but the relationship of these stocks to the offshore fisheries is unclear due to an absence of direct data on offshore distribution and migration patterns.

Herring research is difficult to conduct in the Bering Sea due to the large area, the lack of funding, the highly mobile nature of the herring, and the generally poor weather and sea conditions.

7.5 Ecological Relationships

7.5.1 Environmental characteristics

Of the oceanographic processes of the Bering Sea and their year-to-year variations, the following are the most significant for the biota: (1) year-to-year variation of ice cover in the central and south-central part of the Bering Sea shelf; (2) the autumnal turnover of water masses on the shelf (returning nutrients from deeper layers and near the bottom to surface layers); (3) monthly surface layer temperature anomalies (up to 3°C) in the central and southern Bering Sea; (4) formation of subzero bottom temperatures on the Bering Sea shelf; and (5) rapid flushing of the Aleutian Islands shelves (Hood and Kelly, 1974).

7.5.2 Biological characteristics

The Bering/Chukchi region is a typical area of the northern temperate zone. It has relatively few species, among which some dominate quantitatively to a high degree over the others. In scarcely any other ocean region is one fish species quantitatively so dominant as pollock in the Bering Sea. Rather pronounced cannibalism occurs in dominant species in general and cannibalistic interactions cause long-term quantitative changes in the ecosystem complex.

The most pronounced biological characteristic of the region is the presence of large numbers of marine mammals (e.g. 1.4 million fur seals) and birds (approximately 10 million shearwaters arriving each summer, Bering Sea Groundfish FMP, 1979), which consume together many times more fish than the commercial catch of all nations from this region.

Another general biological characteristic of the Bering Sea is the relatively high basic organic productivity. This high productivity is largely caused by deep autumn/winter turnover which returns regenerated nutrients to the surface layers. This high organic production (combined with relatively slow decomposition rate of organic detritus in colder waters) causes the presence of a high standing crop of larger zooplankters (euphausiids) and boreal squids (gonatid squids), which in turn serve as an important food source for herring and other fish (and partly for mammals and birds).

7.5.3 Ecosystem characteristics

In the marine ecosystem there are intensive interactions between different species, their prey items, and environmental factors. Changes in abundance and distribution of one species (e.g. caused by a fishery) affect the abundance and distribution of other species as well. Ideally, fisheries management requires the quantitative knowledge of all of these interactions. Single species population dynamics approaches are no longer fully adequate.

The quantitative processes in the marine ecosystem are beginning to be simulated and studied with numerical, dynamic, deterministic marine ecosystem reproduction models. A few results from the Dynamic Numerical Marine Ecosystem Model (DYNUMES III), currently in use at the Northwest and Alaska Fisheries Center, Seattle, are briefly summarized in this section.

The DYNUMES model permits the computation of the main component of "natural mortality" -- i.e. grazing (consumption) and the portions grazed, for instance, by mammals and by other fish (Figure 7-9). Grazing is based in trophodynamic computations. Using the DYNUMES III model, Laevastu and Favorite (1978) estimated that the consumption of herring by marine mammals, birds and fish may be many times greater than the commercial catch. These estimates

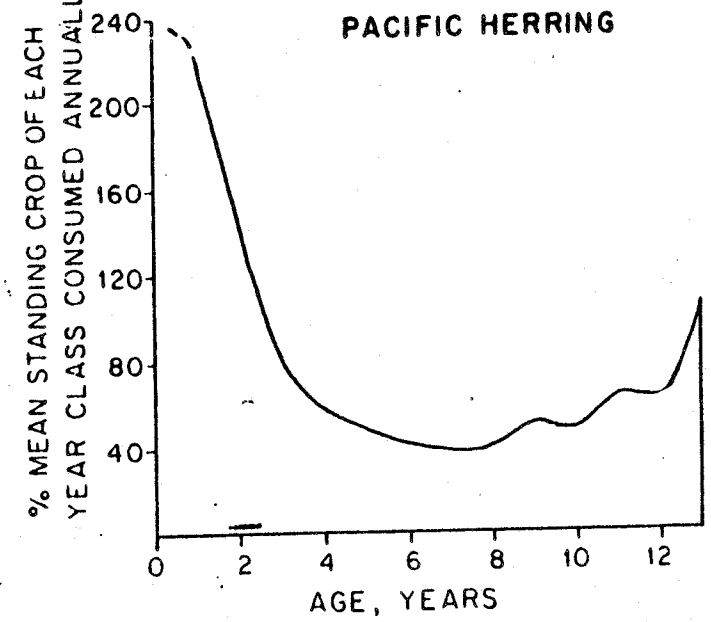

Figure 7-9. Total mortality by age expressed as percent loss of biomass of Pacific herring.

illustrate the importance of herring as a forage fish and the magnitude of predation as a source of natural mortality. Predators should generally benefit from the stabilization or increase in the populations of herring and other fishery resources which is one of the goals of the fishery management plans being developed under the Magnuson Act.

Pollock and herring

The DYNUMES III model describes a long-term inverse relationship between herring and pollock due to older pollock preying on herring (Laevastu and Favorite 1978). The decline in herring abundance a few years ago was coincidental with high abundance of pollock; an increase in herring abundance is currently indicated which in part may be in response to the decrease in the abundance of older pollock. There may also be severe competition for food between young pollock and herring since both feed extensively on pelagic invertebrates.

Salmon and herring

Although all species of salmon feed to some extent on fish, chinook (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) appear to be the most dependent on fish in their diet. The average volume of herring in chinook salmon stomachs ranged from 34-46% and that in coho salmon stomachs from 13-34% based on a study conducted in British Columbia waters during 1939-1941 (Pritchard and Tester 1944).

Healey (1976) in the course of reexamining whether the removal of herring by British Columbia's purse seine fishery would harm the Province's chinook and coho resources, effectively summarized the existing information on the diet of the two salmon species. He considered only fish over 30 centimeters in length, as smaller salmon are reported to feed only to a very limited extent on fish. He found that all species of salmon feed on a wide range of organisms, but only a few types of organisms form the bulk of the diet. Diet is extremely variable from time to time and place to place. Within broad limits of preference, chinook and coho salmon appear to be opportunistic feeders. Although they have a general preference for fish, they may be found stuffed with

invertebrates. Among fish, clupeoids (particularly herring and anchovy) and sand lance were the most common diet items of chinook and coho salmon although young rockfish and various smelts were consumed regularly. Among invertebrates, euphausiids were an almost universal food. Other important invertebrate groups were amphipods, crab megalops, and squid.

With the possible exception of chinook salmon, the majority of western Alaska salmon overwinter in the northeastern Pacific and reside in the Bering Sea during early summer to fall (Fredin, et al 1977). Some chinook salmon are taken in foreign trawls fished during the winter months in the Pribilof Islands area. These salmon are probably feeding on herring to some extent. Very limited information is available on the feeding habits of Western Alaska salmon throughout their range, but Ito (1964) found that the principal food items of chinook and coho salmon in the Northeastern Pacific were squid and euphausiids. Although herring are no doubt consumed by salmon in the Bering Sea, salmon dependency on herring in this region does not appear to be as great as in more southerly latitudes where salmon are year-round residents.

Marine mammals and herring

Numerous species of marine mammals are known to consume herring: northern fur seal, spotted seal, harbor seal, northern sea lion, ribbon seal, killer whale, ringed seal, harbor porpoise, Dall porpoise, beluga, fin whale, and humpback whale. In addition the minke whale may eat herring. The sei whale eats herring in lower latitudes, but not in the area covered by this FMP. The food habits of the fur seal (Callorhinus ursinus) have been the most thoroughly studied. Herring is a principal component of their diet off southeast Alaska and British Columbia forming in most cases over 90% of their diet during the winter (Perez and Bigg, 1980). Herring was found in fur seal stomachs taken around the Pribilof Islands and near Unimak Pass in 1962, 1963 and 1964 where it formed 6%, 5% and 37% respectively of the stomach contents by volume. However, it was not found in this area in 1973 or 1974. Walleye pollock, capelin and gonatid squid are the principal diet of fur seals in the Bering Sea.

Although extensive published data are lacking for the southeastern Bering Sea, herring are considered to be a major component of the summer diet of harbor seal (Phoca vitulina richardii) and spotted seal (P. largha) (Lowry et al. 1978). Recent studies have also documented the importance of capelin and pollock for these species. Spotted seals taken in the southern Chukchi Sea during July and October were feeding extensively on herring. The spotted seal depends greatly on coastal spawning herring as a major component of its diet. Its seasonal, shoreward migration is timed to coincide with the appearance of herring. The largest coastal aggregations of spotted seals are on top of the spawning schools of herring (Burns, pers. comm.). Appendix 2 provides additional information for each species.

7.6 Current Status of Stocks

In the late 1960s and early 1970's, herring abundance in the eastern Bering Sea declined significantly. This was indicated by the catch and CPUE of trawlers on the winter grounds (Figure 7-10) and by reports from subsistence fishermen along the coast. The CPUE (mt/hr) for Japanese large stern trawlers decreased from a high of 6.80 in 1969-70 to 0.77 in 1973-74. The CPUE of small stern trawlers also declined. The CPUE of the Japanese gillnet fishery exhibited no trend, presumably because the vessels were targeting on spawning concentrations which may not reflect population abundance (Wespestad, 1978A).

The catch and CPUE of foreign trawlers may no longer be useful as indicators of herring abundance, since herring are now exclusively incidental catches to other fisheries.

The best indicaton of current herring abundance is the results from ADF&G aerial surveys which have been conducted in coastal spawning areas annually since 1976. These surveys determine the relative abundance of herring through an index based on school counts weighted by surface area (Barton, 1979). These abundance indices are combined with age frequency data from the fisheries and research catches to determine stock conditions.

Aerial surveys indicated an increase in herring abundance in all major spawning areas during the 1976-79 period (Table 7-4). The longest series of

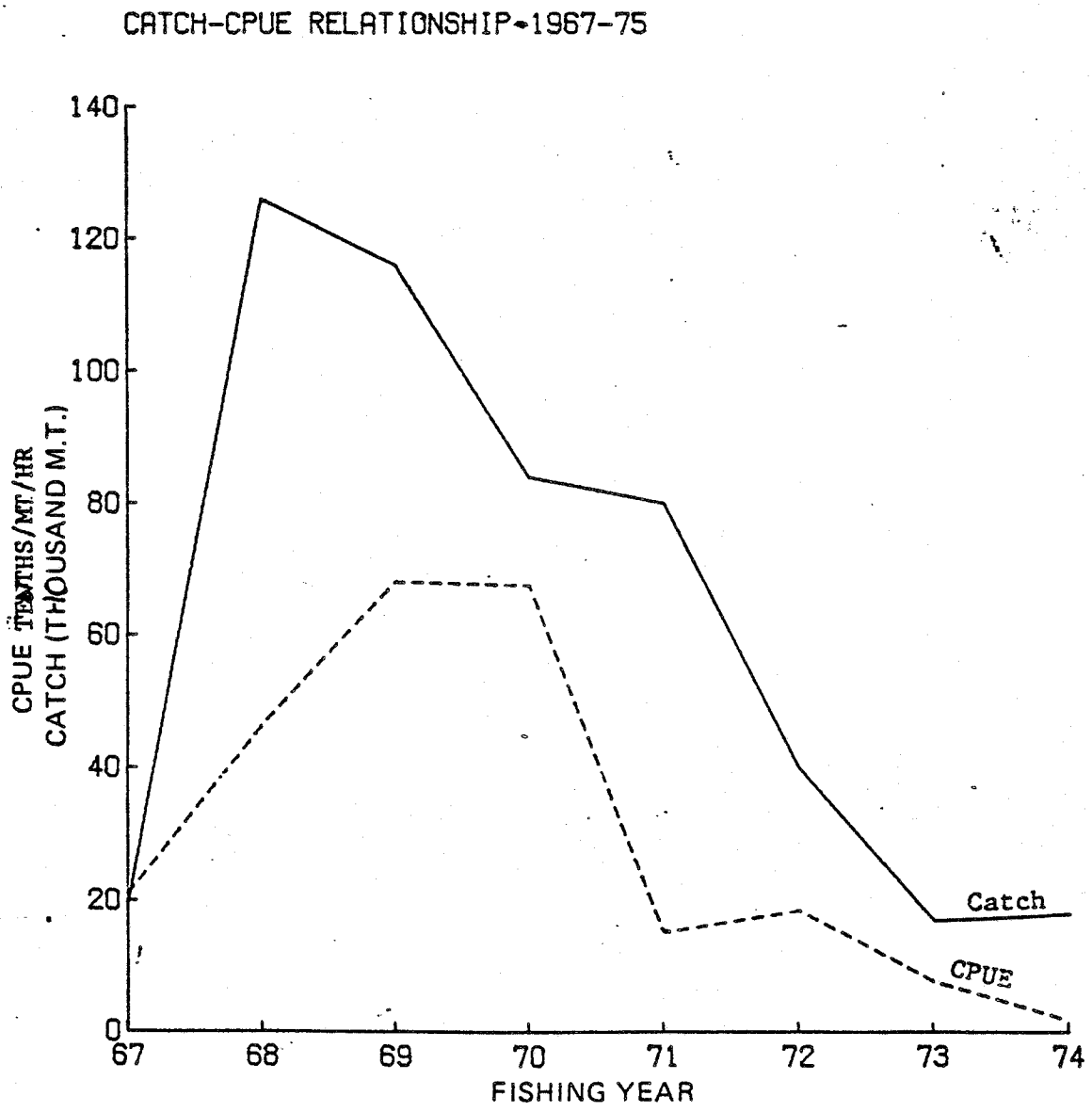

Figure 7-10. Catch and catch per-unit-effort relationship for large Japanese stern trawlers (vessel size 6-8) in the eastern Bering Sea, 1967-1974.

Table 7-4. Relative abundance indices of spawning herring in major spawning areas of the eastern Bering Sea.[1/]

Area	1975	1976	1977	1978	1979	1980	1981	1982
Bristol Bay	--	4,162	8,732	43,050	137,630	15,249	79,352	49,998
Goodnews Bay/ Security Cove	95	10	209	487	6,641	3/	3,821	1/
Nelson Island	174	336	320	1,079	2/	2/	1,072	3/
Norton Sound: St. Michaels to Unalakleet	0[4/]	40	1	1,806	1,860	2,242	6,516	4,548

Relative abundance indices of spawning herring standardardized to 1976 in major spawning areas of the eastern Bering Sea.[2/]

	1975	1976	1977	1978	1979	1980	1981	1982
Bristol Bay	--	1.0	2.1	10.3	33.1	3.6	19.1	12.0
Goodnews Bay/ Security Cove	9.5	1.0	20.9	48.7	664.1	3/	382.1	1/
Nelson Island	0.5	1.0	1.0	3.2	2/	2/	3:2	3/
Norton Sound: St. Michaels to Unalakleet	0.0[4/]	1.0	--	45.2	46.5	56.1	162.9	113.7

1/ Relative abundance indices are corrected school counts weighted by surface area obtained from aerial surveys.
2/ Security Cove data only. Goodnews Bay data incomplete due to turbid water.
3/ Data incomplete due to turbid water.
4/ Minimal survey effort.

aerial counts is from southern Norton Sound; it extends back to 1968. The early surveys in this series supported the trawl CPUE data in indicating a decrease in abundance during the early 1970's.

Length and age frequency data indicate that catches in the late 1960's and early 1970's were composed of larger and older herring than in the past few years (Table 7-5). These data suggest that recruitment was poor until recently and may have been a major contributing factor to decreased herring abundance. Recruitment appears to have increased beginning with the 1972 year class (Figure 7-11). Age 4 herring comprised 54% of the Togiak catch in 1976, accounted for 50% of the catch in 1977 and in 1978 comprised 65% of the purse seine catch. In 1979, the recruitment of age 4 herring decreased from that observed in 1976-78; however, age 3 fish were present in higher amounts than in the recent past.

A major problem in assessing the current status of stocks is a lack of knowledge on stock interrelationships (Section 7.2). If these relationships were better understood, it would be possible to use estimates of herring abundance on the high seas to predict the strength of future spawning runs.

7.6.1 Maximum sustainable yield

Herring populations are subject to significant changes in abundance over relatively short periods of time. It appears that these changes may result from changing environmental conditions and/or be related to fishing pressure. Because of this aspect of herring population dynamics, the maximum sustainable yield (MSY) concept does not provide a good indicator of the level of harvest that should be allowed in a given fishing year. MSY is a measure of the average maximum annual yield of the fishery over a long period of time. An estimate of the MSY for eastern Bering Sea herring can be calculated by first estimating the average size of the virgin resource. Two methods have been used to do this: (1) estimates based on early Russian hydroacoustic trawl surveys and (2) ecosystem modeling. Each method has its limitations and at present, it is difficult to determine the accuracy of either. The following is a description of each method.

Table 7-5. MEAN LENGTH OF HERRING TAKEN IN THE FISHERIES BY ALL GEAR IN ALL MONTHS IN THE EASTERN BERING SEA AND ALASKA COASTAL WATERS. A/

	FOREIGN TRAWL FISHERY			COASTAL FISHERY		
YEAR	MEAN LENGTH (CM)	SAMPLE SIZE	PROBABLE AVERAGE AGES	MEAN LENGTH (CM)	SAMPLE SIZE	LOCATION OF SAMPLE
1964	26.60	3,101	7	23.30	339	NORTON SOUND
1965	29.83	155	8-9			
1966	27.16	48	6-7			
1967	26.20	99	5-6			
1968	29.04	4,771	8-9	28.60	350	BRISTOL BAY
1969	30.66	3,951	9-10			
1970	30.81	3,813	9-10			
1971	29.21	4,299	8-9			
1972						
1973						
1974						
1975						
1976			3-4	20.11	791	BRISTOL BAY
1977	23.40B/	1,981	4-5	23.00	2,847	BRISTOL BAY
1978	23.28C/	3,607	4-5-6	23.27	1,031	BRISTOL BAY

A/STANDARD LENGTH FOR ALL COASTAL SAMPLESFORK LENGTH FOR FOREIGN SAMPLES PRIOR TO 1978.
B/FORK LENGTH(NOV.1976-FEB.1977)ESTIMATED STANDARD LENGTH IS 22.4CM.
C/STANDARD LENGTH(DEC.1977-JAN.1978)

SOURCES: FOREIGN FISHERY: FISHERIES AGENCY OF JAPAN THROUGH INPFC RUMYANTSEV AND DARDA 1970
U.S. OBSERVERS ON JAPANESE AND SOVIET VESSELS.
COASTAL FISHERY: ALASKA DEPT.FISH AND GAME,1964 ANNUAL REPORT;BRISTOL BAY DATA REPORT NO.17; BARTON ET AL.1977;WARNER&SHAFFORD 1977.

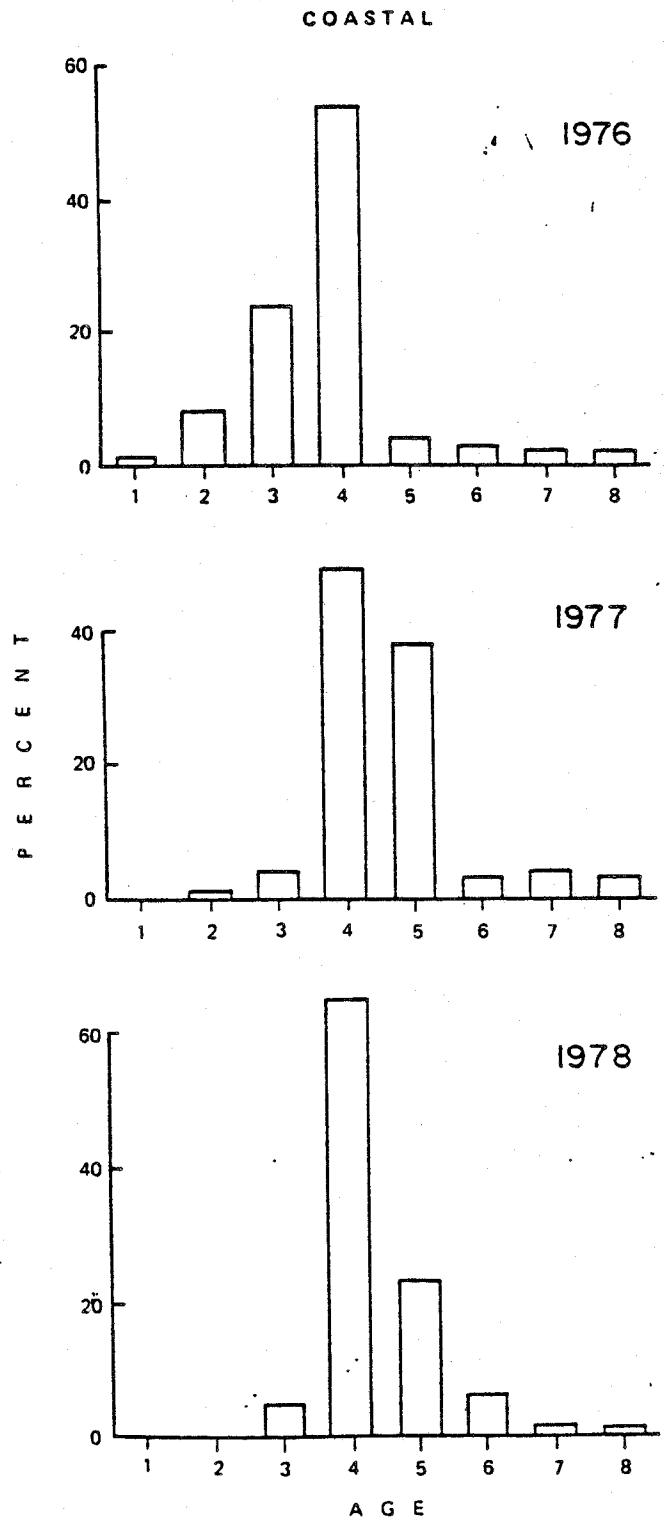

Figure 7-11. Age frequency of herring in the Bristol Bay herring roe fishery 1976-1978.

In 1963, three years after the fishery began, the eastern Bering Sea herring biomass was estimated to be 2.16 million mt based on a Soviet hydroacoustic survey of the wintering grounds (Shaboneev 1965). Using the same data, a recent paper by Kachina (1978) reduced this earlier estimate to 0.374 million mt by using a lower mean school density of 0.5 fish/m^3 compared to 3.38 fish/m^3 used for the original estimate.

According to Shaboneev, schools were surveyed at night and the area and height of schools were charted acoustically. School composition and age distribution were determined by trawling. The original density (3.38 fish/m^3) was determined by comparing acoustic echograms from the eastern Bering Sea to echograms of schools sampled by purse seines in western Bering Sea coastal waters. The revised density estimate of 0.5 fish/m^3 is based on observations from subsequent surveys of herring concentrations on the winter grounds northwest of the Pribilofs during 1969-71 (Fadeev, personal communication).[1/]

The densities derived are questionable but cannot be fully evaluated because few specific details regarding Soviet survey methods and accuracy are available. However, data reported in the literature and from individuals involved with herring hydroacoustic surveys indicate that the range of densities used by the Soviets may be extreme and an intermediate value may be more realistic.

There are also other sources of potential error in these estimates. The smaller herring stocks in northern areas may not have been included in the Soviet hydroacoustic survey and the age distribution data reported by Shaboneev indicate that age-1 fish were not included and age-2 fish only partially included in the survey. These factors would tend to bias the biomass estimate downward.

A numerical ecosystem model was applied to estimate biomass of eastern Bering Sea herring (Laevastu and Favorite 1978). This model simulated herring abundance based on the amount of herring needed to sustain the diet of herring predators at reported rates of consumption. Although the accuracy of

1/ Fadeev, N. Pacific Institute of Fisheries and Oceanography (TINRO), Vladivostok, USSR. Information presented at US - USSR Scientific meetings, Seattle, WA, June 5-8, 1979.

input parameters, such as size of predator populations and consumption rates, has not yet been sufficiently evaluated, this model estimated that a stock size of 2.75 million mt of herring is required to maintain components of the ecosystem including predators at a level observed in the mid-1960's prior to the start of intensive fishing.

Calculation of MSY from each estimate of virgin biomass can be accomplished by applying a method developed by Alverson and Pereyra (1967) for obtaining first approximation of yield from an unexploited biomass (MSY = 0.5 MB, where B = virgin biomass and M = natural mortality of 0.47). The resultant MSY values are provided in Table 7-6.

A third estimate of MSY can be derived by average annual catch data for the foreign fishery over the long term. The average long term catch is 48,712 mt. This figure was calculated using the total catches from 1962 after the fishery developed up to 1976, after which date the fishery was curtailed, and excluding 1967 when data were unavailable (Table 3-7). Data from 1977-79 were not used in this calculation because foreign fisheries were limited by low quotas established in the PMP. Assuming an exploitation rate of 0.2 (see Section 7.6.2.2) the estimated biomass would be 243,560 mt.

Table 7-6. Estimation of biomass and MSY

Estimated Biomass (million mt)	Estimated MSY (mt)	Biomass Data Source
2.750	194,000[1/]	Ecosystem Model (Laevastu and Favorite 1978)
0.374 - 2.16	88,000-507,000	Hydroacoustic Survey (Shaboneev 1965, Kachina 1978)
0.243[2/]	47,812	Average Catch 1962-76

1/ Assumes 30% of biomass is available for exploitation.
2/ Assumes a 20% exploitation rate.

The actual performance of the foreign fishery from 1962-76 indicates that MSY estimates in excess of 100,000 mt may be too high. The overall abundance of herring decreased during this period. Some of the decrease may have been due

to environmental conditions, but the period over which the catch was averaged is relatively long (14 years), so that positive and negative environmental factors should have balanced to some degree.

It is difficult to determine which estimate of MSY is the best, since each method is based on different sets of assumptions which may or may not be valid. It is evident from all indices of stock abundance that herring stocks declined in the early 1970's and are now increasing. Choosing the appropriate level of MSY depends on whether declines were due to excessive fishing mortality or environmental factors causing poor survival. If the declines were due to overfishing then MSY is likely near the average catch. However, if declines were due to poor recruitment, then MSY may be greater than the average catch level but is dependent on the magnitude and frequency of population fluctuations.

Given the lack of definitive biomass data, it appears reasonable to use the long term average catch of 48,712 mt as an estimate of MSY. This figure is considered the best available and will apply until better data are available. It may be revised as additional research information and catch statistics become available.

7.6.2 Acceptable biological catch

Because the herring population of the Bering Sea fluctuates significantly, the Acceptable Biological Catch (ABC) in any given year must reflect current stock conditions to the maximum extent possible. Therefore, ABC shall be determined annually and may be adjusted during the year as new information becomes available. The ABC determined under this plan applies to the combined state and federal management areas. The method of determination is as follows:

7.6.2.1 Spawning biomass estimation

Since 1977, ADF&G has performed aerial surveys along the western Alaska coast during the spawning period. The purpose of these surveys is to count schools of herring which are then recorded according to total surface area. Estimates of the spawning biomass are then obtained by applying a density factor to the

total surface area of all schools recorded on the peak day in each spawning area. Using this technique, the spawning biomass in 1978 from Bristol Bay to Norton Sound was estimated to be 187,210-334,723 mt and estimates for 1979 were 258,079-637,583 mt (Barton and Steinhoff 1980). The estimate generated by ADF&G in 1982 (excluding Nelson Island) was 116,000 mt (Table 7-7).

The spawning biomass estimate does not include any data from the Aleutian Islands/Alaska Peninsula area or from the Port Clarence/Kotzebue Sound region. Reliable spawning biomass estimates do not presently exist for either of these areas. When spawning biomass estimates are available they will be included in the spawning biomass estimation used to determine ABC.

Despite the problems with the method, the spawning biomass estimates developed by aerial surveys are the best available. Until additional data become available through hydroacoustic surveys, spawn deposition surveys, or other sources, the aerial surveys shall be the basis for determining annual spawning biomass.

In the past, there have been times when ice and weather conditions have been such that aerial surveys could not be conducted to accurately assess spawning biomass. When spawning surveys are limited by these or other factors, the primary stock assessment tool will be virtual population analysis (VPA or cohort analysis). VPA is based on data generated from previous years' inshore and offshore surveys. The biomass of each year-class of herring is computed and subjected to an estimated annual mortality (a combination of natural and fishing mortality). An estimate of recruitment into the fishery is also computed. The current biomass estimate is then the sum of the computed biomass estimates for each year-class and the predicted recruit biomass.

If it is not possible to determine herring abundance by using aerial surveys or VPA, stock condition will be assessed by using commercial catch rates, the percentage of roe recovery, ratios of pre to post spawners from test net and commercial catches (both inshore and offshore), spawn deposition observations and any other available information.

When virtual population analysis or other methods are used to provide biomass estimates, those estimates must be reduced to a spawning biomass estimate before they may be used to determine ABC.

Table 7-7. Estimated biomass and commercial harvest of Pacific herring in eastern Bering Sea fishing Districts, Alaska, 1978-1982.

1983 167,800 30,750 18.3

District	Biomass (m.t.)	Harvest (m.t.)	Roe %	Estimated Value (dollars)	% Biomass Harvested
1982					
Togiak	88,800	19,556	8.8	6,174,300	22.
Security Cove	4,600	737	9.3	271,000	16.
Goodnews Bay	2,400	441	9.5	187,900	18.
Cape Romanzof	4,400	596	9.3	221,700	13.
Norton Sound	15,800	3,567	8.8	1,046,200	22.
Total	116,000	24,897	8.9	7,630,100	21.
1981					
Togiak	143,900	11,374	9.1	3,988,000	7.
Security Cove	7,500	1,064	8.1	347,070	14.
Goodnews Bay	3,900	596	7.7	196,170	15.
Cape Romanzof	4,400	653	8.0	211,260	15.
Norton Sound	22,800	3,965	8.8	1,500,000	17.
Total	182,500	17,652	8.9	6,242,500	9.
1980					
Togiak	62,300	17,774 1/	9.2	3,205,000	28.
Security Cove	1,100	632	8.2	151,000	57.
Goodnews Bay	1,100	406	9.5	97,000	36.
Cape Romanzof	2,700	554	9.8	132,000	20.
Norton Sound	7,600	2,224	8.1	500,500	29.
Total	74,800	21,590	8.8	4,085,500	28.
1979					
Togiak	216,800	10,115	8.6	6,700,000	4.
Security Cove	19,500	385	8.5	327,000	2.
Goodnews Bay	6,700	82	4.7	38,500	1.
Cape Romanzof	2,700	0	-	-	0.
Norton Sound	7,000	1,172	7.0	628,200	16.
Total	252,700	12,406	8.0	7,694,000	4.
1978					
Togiak	172,600	7,033	8.2	2,300,000	4.
Security Cove	1,200	259	-	-	21.
Goodnews Bay	400	0	-	-	0.
Cape Romanzof	2,700	0	-	-	0.
Norton Sound	4,800	13	-	-	0.
Totals	181,700	7,305	8.2	2,300,000	4.

1/ Does not include an estimated 5,200 m.t. of waste.

7.6.2.2 Exploitation rates

Once an estimate of the spawning biomass has been established, the level at which ABC is set will depend on the exploitation rate that is applied. In other herring fisheries, several methods of determining an appropriate exploitation rate have been used. These are briefly summarized below.

In the northeastern Pacific, herring are generally managed for escapement (egg deposition). The rate of exploitation is set in the range of 10-30%. In British Columbia, escapement is set at a level that historically produced the greatest recruitment; herring that are surplus to escapement requirements are harvested. Using this method, Canadian biologists estimate that the rate of exploitation has averaged 20-30%. In Southeastern Alaska, optimum escapement is unknown but stock abundance is known to be low and only 10 percent of the estimated biomass is harvested in order to increase abundance. When a stock is below a determined minimum biomass, no fishing occurs, and if strong year classes are present, 20% of the biomass may be harvested.

In Washington, the herring exploitation rate has been determined to be 20 percent based on the assumption that at this rate, fishing mortality approximately equals the rate of natural mortality (Trumble, pers. comm.)[1/] Also it is assumed that at this level the stock will be protected from sharp reductions due to recruitment failures and that herring are maintained at a level that provides adequate forage for predators (i.e., salmon).

Exploitation of many Atlantic herring stocks is based on yield-per-recruit analysis (Beverton and Holt 1957). The yield-per-recruit model defines a point of maximum yield-per-recruit for a given age of entry into the fishery and rate of fishing mortality. However, herring do not generally have a maximum, but rather yield increases with increasing fishing mortality (Figure 7-12). Since the yield-per-recruit/F curve is rather flat, fishing mortality can be reduced from maximum without much loss in yield. At a lower than maximum rate of fishing mortality a larger stock size is maintained and

1/ Robert Trumble, Washington Dept. of Fisheries, Seattle, WA.

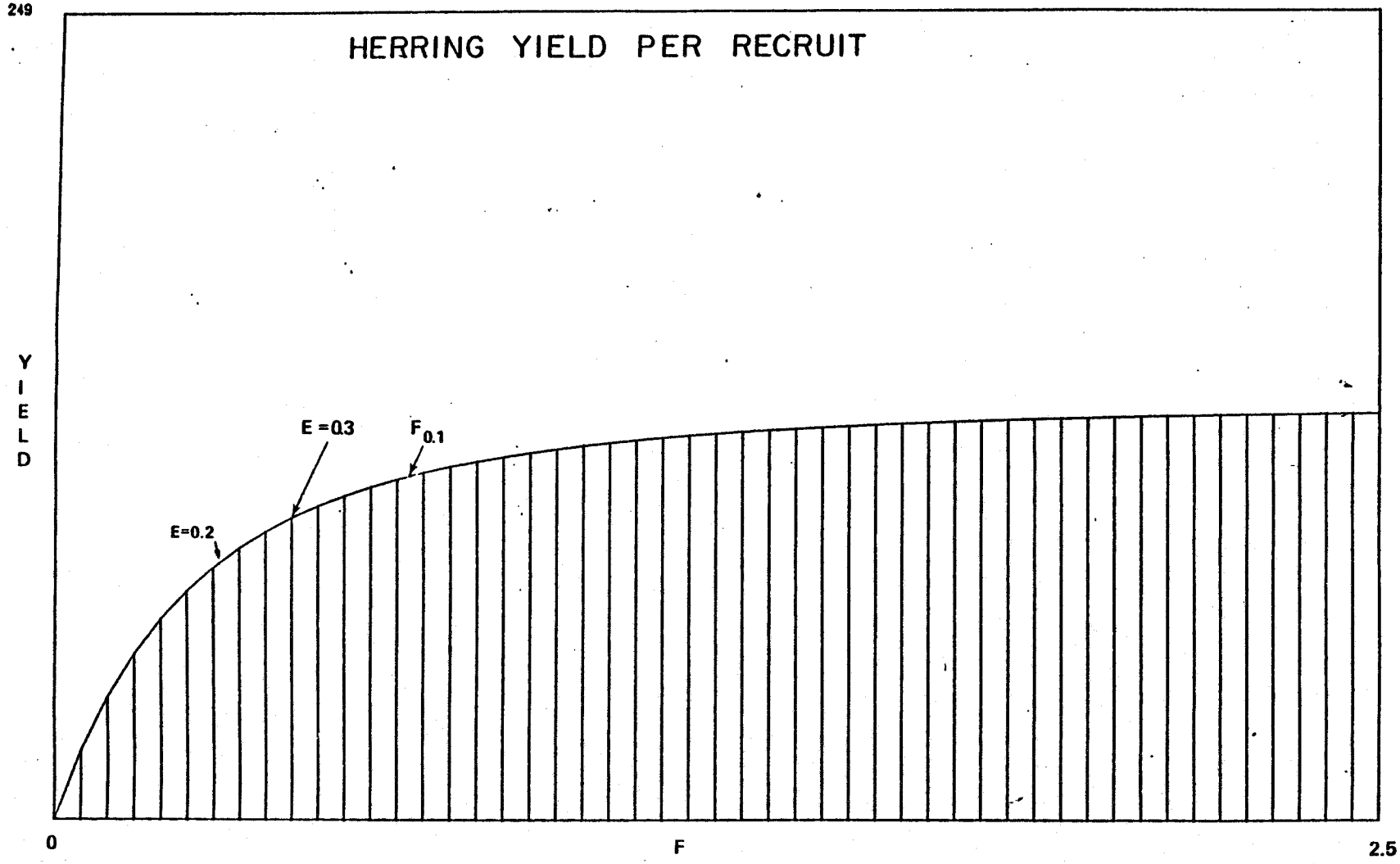

Figure 7-12. Herring yield per recruit at various levels of fishing mortality (F) (in 0.05 increments) and yield at 3 levels

the fishery is more stable since more ages are in the fishery. The conventional lower rate of fishing mortality used is the $F_{0.1}$ level, which is the level at which the increase in yield-per-recruit from an additional unit of fishing mortality is 10% of what the yield would have been for a unit of fishing mortality on the virgin stock (ICNAF 1976). The $F_{0.1}$ rate for eastern Bering Sea herring occurs when F = 0.675 and the exploitation rate corresponding to this level of fishing mortality is 39%.

Thus, the range of exploitation rates which could be considered for the eastern Bering Sea herring fishery is 10-39%. There are a number of factors which indicate that a conservative rate within this range should be selected:

(1) The fishery in its present form has a very short history so that there is not a lengthy data base to analyze;
(2) the accuracy of biomass estimates is unknown;and
(3) biological relationships are little known.

Together, these factors indicate that under average conditions an exploitation rate of 20% would be appropriate in view of currently available data. If abundance indices were low, or if future recruitment was anticipated to be poor, then a rate less than 20% should be applied.

A method of determining the appropriate level of exploitation is to assume that MSY is obtained at an exploitation rate of 0.2 (E_{msy}). This means that the biomass level (B_{msy}) that produces MSY is equal to MSY/.2 or 48,712/.2 = 243,560 mt.

When stocks are at a level that will produce MSY, the exploitation rate is equal to .20. However, biomass will not always remain at MSY; rather, it will fluctuate around MSY in response to growth, recruitment and mortality. To adjust exploitation when the current biomass estimate is below the MSY biomass, the exploitation rate will be adjusted by the ratio of current biomass to MSY biomass, or:

$$E_t = \frac{B_t}{B_{msy}} \times E_{msy}$$

for example, if B_t = 200,000 mt, then

$$E_t = \frac{200,000}{243,560} \times .20 = .16$$

Until a better estimate of the current biomass becomes available the spawning biomass estimate (Section 7.6.2.1) will be used.

Because of the uncertainty in the determination of MSY it has been determined that the exploitation rate shall not exceed 20%. This limitation shall be reviewed when better data are available to determine MSY.

7.6.2.3 Determination of ABC

Annually by July 1, ABC shall be estimated by the Regional Director of the NMFS according to the procedure described below. This estimate shall be reviewed by the Council and its advisory groups. The Council shall provide for public comment on the estimated values and procedures.

The Council shall on October 1 recommend a final value of ABC to the Assistant Administrator or the Alaska Regional Director, NMFS, who will specify the final values. The ABC so specified will be for the current fishing year.

$$ABC = Et \times B_t$$

$$= [\frac{\text{spawning biomass estimate}}{\text{MSY biomass}} \times 0.2] \times \text{spawning biomass estimate}$$

7.6.2.3.1 Spawning biomass estimate

Spawning biomass estimates will be determined in accordance with Section 7.6.2.1. The most current data available at the time of determination of ABC shall be used.

Spawning biomass estimates for Nelson Island will be excluded from the spawning biomass estimate. This exclusion is intended to provide an additional degree of protection for the subsistence fishery in this area.

7.6.2.3.2 MSY biomass

In accordance with Section 7.6.1 the best available estimate of MSY biomass is 243,560 mt.

7.6.2.3.3. Limitations on exploitation rate

In accordance with Section 7.6.2.2. the exploitation rate may not exceed 20 percent. If the spawning biomass estimate divided by the MSY biomass is greater than 1, then the exploitation rate (E_t) is set equal to 0.2.

8.0 HERRING MANAGEMENT ISSUES

This section directly addresses several issues which are relevant to the consideration of OY.

8.1 Maintenance of the Subsistence Herring Fishery

The subsistence harvest of herring during the spawning season has been an important source of food to Alaska Natives living along the Bering Sea coast for centuries. This subsistence fishery is described above in Section 3.1 of this FMP.

By far the greater part of the subsistence harvest has, in recent years, been taken in and around Nelson Island. The herring stocks spawning in this area are believed, however, to constitute a very small portion of the total Bering Sea herring biomass, and are dwarfed by the stocks that are harvested commercially around Togiak. There is little direct evidence of the migratory pattern followed by the Nelson Island stocks when they move offshore, or on the extent to which these stocks remain discrete while at sea, rather than mixing more-or-less randomly with stocks spawning in other areas. As a result, Alaska Natives who are dependent upon the Nelson Island stocks for subsistence have expressed concern that even a limited and closely regulated offshore harvest of herring could pose a significant danger to their livelihood.

This FMP addresses this concern in a number of ways. Inasmuch as inshore herring fisheries are inherently more amenable to sound management than offshore fisheries due to the inshore segregation of the various spawning stocks and their greater visibility, this FMP recognizes the preference accorded inshore, and particularly, subsistence fisheries.

This FMP recognizes the mortality of herring which occurs incidentally in the domestic and foreign groundfish trawl fisheries. The FMP sharply limits this mortality by establishing an allowable incidental catch (AIC) for the U.S. groundfish fishery and a Prohibited Species Catch (PSC) for foreign groundfish fisheries. If a nation's groundfish trawl fishery has reached its AIC or PSC of herring all trawl vessels of that nation are excluded from a large portion

of the Bering Sea where herring congregate during the winter months. This area, called the herring savings area, is also a major trawl fishing area for important groundfish species. The threat of exclusion from this area and the resulting disruption of normal fishing patterns will provide a strong incentive for each nation to sharply curtail its incidental catch of herring.

The FMP also reduces the potential damage to subsistence stocks by directed offshore harvest of herring through its determination of the spawning biomass estimate and exploitation rates. Nevertheless, concern has been expressed by some subsistence users regarding the need to obtain more direct information on offshore stock distribution, a process that may take many years. These concerns are offset to some degree by such evidence as the fact that during 1976, 1977, and 1978, the offshore harvest of herring was considerably higher than it will ever be under the FMP; yet, during the same three years the Nelson Island stock increased by three times, the Bristol Bay stock by 10 times, and the Goodnews Bay/Security Cove stock by almost 49 times (see Tables 3-7 and 7-4). While such evidence is not conclusive, it establishes the extreme unlikelihood that the smaller herring stocks utilized for subsistence are distributed offshore in such a pattern as to facilitate the catastrophic results feared by some subsistence users. These data seem, instead, to strengthen the theory of those scientists who believe that the stocks spawning from Bristol Bay to the Yukon Delta mix fairly randomly while offshore, a condition that would tend to protect the smaller stocks during the offshore sojourn.

In order to further allay concerns of subsistence fishermen, the Council has selected a very conservative management system for the offshore fisheries. The winter apportionment of OY is reduced by 50% and a winter fishery of greater than 10,000 mt or less than 2,000 mt is not allowed. Also if the spawning biomass estimate is less than one-half of the MSY biomass the winter apportionment of OY is set equal to zero. Further, in recognition of subsistence harvests that occur in other areas, 500 mt is subtracted from ABC in the determination of the winter apportionment of OY. Both the summer and winter apportionments of OY may be further reduced if problems arise with the spawning stocks with special focus on the subsistence stocks.

8.2 Development of Domestic Herring Fisheries on the High Seas

Considerable interest has been expressed by domestic fishermen and processors in a fishery for food or bait herring in the Bering Sea. In spring of 1979, a food fishery was conducted off the Pribilof Islands by American fishermen for the first time, in a joint venture with a Russian processing vessel. The total catch was low due to the displacement of the operation by unseasonal ice conditions. This fishery would probably occur during the winter months when the oil content of herring is high and when the fish are concentrated on their wintering grounds.

The major advantage of a high seas herring fishery is that it would allow improved utilization of the herring resource. Because of unusually high herring abundance, adverse weather, or ice conditions, the inshore fisheries may not consistently take the allowable harvest, even after the fishery has fully developed and stabilized.

A second advantage of a high seas fishery is that the domestic fishery would not be entirely dependent on the Japanese roe market. If a high seas fishery were developed to a limited extent, there would be greater potential to rapidly expand this fishery should the roe market fail for some reason.

An offshore fishery would also generate data on offshore distribution and abundance, age structure and possibly mixing ratios of various stocks. There would be no other way to generate this information without a massive outlay of research dollars.

The major concern regarding a high seas fishery is that it would operate on an unknown mix of stocks of herring, which may increase the possibility of over-harvesting small stock units. The inshore fisheries have the advantage of operating on more segregated stocks so that the harvest from individual stocks can be closely regulated.

Other disadvantages of a high seas fishery include (1) fisheries monitoring is more difficult to perform on the high seas, which reduces the potential for in-season management adjustments; and (2) the high seas fishery has historically had a lower value relative to the roe fishery. The value of roe herring

taken during the 1979 Bristol Bay fishery was approximately $1500 per short ton delivered in Kodiak compared to an estimated $800 per ton for bait herring taken in the Gulf of Alaska. If a high seas fishery were to develop and capture herring which otherwise would have been taken by the inshore roe fishery, the total value of the harvest might be substantially less than its potential. Recently, however, there have been indications that prices paid for food herring might come to equal or exceed those paid for roe herring, in view of the recent decline in the roe market and improvement in the food fish market. For example, in 1982 Bristol Bay roe herring averaged $350 per short ton (10% roe) while food/bait herring in the Dutch Harbor area averaged $300 per ton.

8.3 Incidental Harvest of Herring in the Groundfish Trawl Fishery

Until recent years, most of the herring harvest in the groundfish trawl fishery was a result of directed effort. However, since the decline of the herring population in the early 1970's, the establishment of reduced catch quotas, and the growth of the pollock population, herring have largely become an incidental species in the groundfish fishery. Since herring have become important in domestic fisheries, it is necessary to control the incidental catch of herring in the groundfish trawl fisheries, especially in years when herring are fully utilized in the roe fisheries.

The best approach to controlling the incidental harvest of herring in the groundfish trawl fishery is to develop a strong incentive for trawling vessels to avoid herring concentrations. Herring are most likely to be caught incidentally when they are concentrated in an area northwest of the Pribilof Islands during the winter months. Traditionally, this is a time and area where major pollock fishing activities also take place. A herring savings area has been designated to protect the herring stocks when they congregate on these wintering grounds.

An allowable catch will be designated for each nation with a groundfish allocation in the Bering Sea/Aleutian Islands area, based on the size of that nation's groundfish allocation. This allocation is referred to as the allowable incidental catch (AIC) for the U.S. groundfish fishery and the Prohibited

Species Catch (PSC) for foreign groundfish fisheries. Domestic fishermen may retain AIC; foreign fishermen may not retain their PSC but must return all herring to the sea. If a nation reaches its AIC or PSC, all or part of the Herring Savings Area will be closed to that nation's trawling vessels from October 1 until March 31, which is the end of the herring fishing year.

The threat of exclusion from this important groundfish fishing ground should provide a major incentive for all trawlers to avoid herring concentrations. However, adequate monitoring of this incidental catch is essential for the success of any program.

Prior to 1982 the majority of the incidental catch of herring in the trawl fisheries was taken in U.S. statistical area II (170°W-180°W, north of 55°N) and only a small amount was taken in other areas of the eastern Bering Sea (Table 8-1). In area II, most of the herring catch has occurred during November-March north of the Pribilof Islands along the outer continental shelf between 100 and 200 meters depth. Japan and the USSR were the principal nations operating in this area during the winter, and together have accounted for nearly all of the Bering Sea trawl herring harvest. U.S. observer records indicate that Soviet vessels fishing during the winter actively sought herring, while Japanese vessels targeted on pollock and attempted to avoid areas with herring concentrations. This pattern was reflected in catch composition which revealed that herring accounted for 0.30-0.66% of the total Japanese catch in area II between 1977 and 1979, while in the Soviet catch herring accounted for 2.76-11.73% (Table 8-2).

The catch composition data indicate a lesser degree of targeting by Japanese vessels, but they do not provide a true measure of the incidental catch rate because they include some unknown amount of direct herring fishing. The best determinants of incidental catch rates are U.S. observer data, but coverage has been insufficient to obtain accurate incidence rates. In the absence of complete observer data, the monthly catch rates by vessel class were used to obtain an approximation of incidental herring catches. Herring catch rates were calculated for Japanese pollock motherships, Japanese small trawlers, and Japanese and Soviet large trawlers in areas I and II only since little or no herring are taken in the other two areas.

Table 8-1. Total groundfish and herring harvests by Japan and the USSR in the eastern Bering Sea by area, 1977-79.

Area	1977		1978		1979	
	Japan	USSR	Japan	USSR	Japan	USSR
Bering Sea						
Total groundfish (mt)	995,841	112,041	1,093,450	220,984	1,019,240	150,776
Total herring (mt)	5,041	13,145	2,315	6,106	1,551	5,718
Percent herring	0.51	11.73	0.21	2.76	0.14	3.79
Area II						
Total groundfish (mt)	690,274	79,512	625,912	101,791	551,852	64,403
Total herring (mt)	4,857	13,145	2,246	6,019	1,515	5,648
Percent herring	0.66	16.53	0.36	5.91	0.30	8.77
Areas I, III, IV						
Total groundfish (mt)	305,567	32,529	467,358	119,193	467,352	86,373
Total herring (mt)	450	0	69	87	36	70
Percent herring	0.15	0	0.01	0.07	0.01	0.08

Table 8-2. Monthly catch of total groundfish and herring by area, nation, and vessel class.

Area/Month	Japan						USSR	
	Pollock Mothership		Small Trawler		Large Trawler		Large Trawler	
	1978	1979	1978	1979	1978	1979	1978	1979
Area I								
1 Total			1,390	2,115	2,048	7		209
Herring			0	0	0	0		41
2 Total			1,681	2,984	1,132	0		
Herring			0	0	0	0		
3 Total			3,046	1,806	1,893	233		
Herring			0	0	0	0		
4 Total			1,567	1,949	1,021	0		0
Herring			0.1	0	0	0	0	0
5 Total			1,226	1,171	5	171	0	
Herring			0.2	0	0	0	0	
6 Total	61,631	18,718	1,736	1,486	9,207	2,765		3,536
Herring	0.8	0	0	1.3	0	0		0
7 Total	54,902	35,641	1,299	1,037	33,391	24,823	121	2,535
Herring	0.7	2.6	0	0	0	1.6	0	0
8 Total	42,105	48,470	1,236	1,796	30,956	52,892	12,458	9,548
Herring	26.6	2.3	0	0	3.6	18.3	0	0.2
9 Total	32,960	37,849	1,264	3,473	24,770	32,762	24,642	17,616
Herring	26.2	1.1	0	0	0	2.8	0	0
10 Total	23,738	29,178	1,767	4,923	18,382	29,263	30,079	25,060
Herring	0.5	0	0	0	0	0.2	0	28.1
11 Total			3,455	4,792	2,065	1,928	22,212	3,722
Herring			0	0	0	0.1	87.2	0
12 Total			1,815	756	2,798	0	5,309	704
Herring			0	0	0	0	0	0
Area II								
1 Total			1,994	3,033	5,748	11,503	24,761	11,851
Herring			104	15.9	0	10.7	2,064	2,153
2 Total			10,775	13,906	23,367	40,414	35,878	21,012
Herring			64.8	48.6	19.8	47.8	1,006	1,236
3 Total			11,709	11,560	31,414	24,373	23,628	11,989
Herring			12.8	48.4	30.6	71.6	382	121
4 Total	611		9,502	9,349	24,581	21,269		6,828
Herring	0		41.8	80.4	33.1	41.6		15
5 Total	59,699	48,462	10,989	4,777		9,771	4,369	12
Herring	11.5	3.5	27.5	0	0	0		0
6 Total	24,822	52,718	3,161	3,273	1,878	4,116		776
Herring	0.3	0.1	0	0	0	0		0
7 Total	52,657	63,640	5,167	4,166	10,407	6,091	194	194
Herring	1.8	0.9	0	0	0	0	0	0
8 Total	96,433	80,908	4,122	2,424	12,258	3,275	326	
Herring	78.5	1.8	0.2	0	1.7	0	0	
9 Total	59,494	57,463	7,562	2,999	19,119	2,574		6
Herring	19.1	1.1	34.8	0	13.6	0		0
10 Total	14,466	28,747	8,982	5,341	16,932	8,756		
Herring	23.0	14.8	222.7	206	9.5	11.7		
11 Total	10,417		16,046	7,467	39,874	19,903	2,790	3,694
Herring	146.6		347.1	76.4	356.8	401	675	439
12 Total			13,326	1,682	6,788	0	14,212	8,040
Herring			437.8	262.4	54.9	0	1,892	1,684

Table 8-2 shows the monthly catches of total groundfish and herring and Table 8-3 shows the proportion of herring expressed as percent of the total groundfish harvest for the different vessel classes in 1978 and 1979. In area I, it can be seen that herring generally accounted for only a very small fraction of the catch with most of the harvest occurring in late summer through autumn as the herring migrate to the winter grounds. For all classes of Japanese vessels, the incidence was one percent to less than five thousandths of one percent. Soviet rates were higher, primarily due to a large amount of herring in a small total catch.

In area II, the variability in the incidence of herring was greater between the vessel classes with Soviet large trawlers and Japanese small trawlers having the highest rates and Japanese pollock motherships and large trawlers the lowest rates. The higher rates of the small trawlers and Soviet vessels were likely due to directed fishing on herring since the total catch of these vessels was much smaller than that of the other two vessel classes.

8.3.1 Importance of allowing an incidental catch

A small incidental catch of herring unavoidably occurs each year in the groundfish trawl fishery of the eastern Bering Sea. Because of the great value of this groundfish trawl fishery, and the importance that is specifically ascribed to its development in Section 2(a)(7) and (b)(6) of the Magnuson Act, the utilization of this small portion of the herring resource in the Bering Sea groundfish trawl fishery contributes to the "greatest overall benefit to the Nation" within the meaning of Magnuson Act Section 3(18). A certain level of incidental catch of herring should thus be allowed in order to achieve the optimum yield of the Bering Sea groundfish fishery. Because the fishery is currently dominated by foreign participants, most of the herring taken in the fishery is currently taken by foreign vessels. As United States participation in the Bering Sea groundfish trawl fishery increases, a greater and greater percentage of the herring taken in that fishery will be taken by United States fishermen.

Table 8-3. Monthly incidence rate of herring in percent by area, nation, and vessel class, 1978-79.

	Japan						USSR	
	Pollock Mothership		Small Trawler		Large Trawler		Large Trawler	
Area/Month	1978	1979	1978	1979	1978	1979	1978	1979
Area I								
1			0	0	0	0		19.6
2			0	0	0	0		
3			0	0	0	0		
4			T	0	0	0		0
5			0.02	0	0	0	0	
6	T	0	0	0.09	0	0		0
7	T	T	0	0	0	T	0	0
8	0.06	T	0	0	0.01	0.03	0	T
9	0.08	T	0	0	0	0.01	0	0
10	T	0	0	0	0	T	0	0.11
11			0	0	0	0.01	0.40	0
12			0	0	0	0	0	0
Mean	0.03	T	T	0.01	T	T	0.06	2.19
Area II								
1			5.20	0.52	0	0.09	8.34	18.17
2			0.60	0.35	0.09	0.12	2.80	5.88
3			0.11	0.42	0.10	0.29	1.62	1.01
4	0		0.44	0.86	0.14	0.20		0.22
5	0.02	0.01	0.25	0	0	0		0
6	T	T	0	0	0	0		0
7	T	T	0	0	0	0	0	0
8	0.08	T	0.01	0	0.01	0	0	
9	0.03	T	0.46	0	0.07	0		0
10	0.16	0.05	2.48	3.86	0.06	0.13		
11	1.41		2.16	1.02	0.90	2.01	24.19	11.88
12			3.29	15.60	0.81		13.31	20.95
Mean	0.21	0.01	1.25	1.89	0.18	0.26	7.18	5.18

T = 0.001-0.005%

domestic fishery does not harvest its AIC apportionment of OY, the remainder shall not be reallocated. AIC may be retained.

When the domestic fishery reaches the AIC the Regional Director shall close all or a portion of the Herring Savings Area (see Section 12.3) and herring caught elsewhere in the Bering Sea may not be retained.

8.3.1.3 Accounting for AIC

To simplify the accounting of herring harvested as DAH or AIC, all herring caught in an area open to directed herring fishing will be charged against DAH. All herring harvested in an area closed to directed herring fishing will be charged against AIC.

8.3.1.4 Designation and accounting of PSC

A PSC will be designated annually for each nation with a groundfish allocation in the Bering Sea/Aleutian Islands management unit. PSC is equal to the incidence rate (0.10%) times each nation's groundfish allocation. It is automatically allocated for the period April 1 to March 31 and is inseparable from the individual groundfish allocations. If a nation does not harvest its PSC the remainder shall not be reallocated.

Although foreign vessels must report all herring caught, this catch must be returned to the sea and will not be considered as part of that nation's groundfish TALFF.

Foreign trawling vessels engaged in processing or buying fish from domestic fishing vessels (joint ventures) will be permitted to do so within the Herring Savings Area after that nation's PSC has been reached as long as those vessels do not employ trawls. Such vessels may, however, retrieve the cod end of trawls that have been employed by domestic vessels.

8.3.1.1 Incidence rate

Determination of a reasonable incidental catch rate for herring from catch data is difficult since many factors cannot be evaluated such as the differences in fishing methods between nations and vessel classes and differences in mesh size. However, in the absence of adequate observer data which would provide a better analysis, a gross approximation can be made using a combination of average rates. As an example, in area I the best estimate of the incidence rate in 1978-1979 was the average rate for Japanese vessels because these vessels accounted for nearly all of the catch and there are no indications that these vessels targetted on herring in this area. Therefore, the best estimate of the rate of herring incidence in area I during this period is 0.009%. In area II, pollock motherships had the lowest incidence rate, but these vessels only fished during the summer and autumn and were not on the grounds during the winter months when herring are more available. Japanese large trawlers, which were on the grounds during the winter months, had the next best rate and also took a larger harvest than Soviet large trawlers or Japanese small trawlers. Averaging the 1978 and 1979 Japanese large trawler herring incidence rate produces an incidental rate for area II of 0.22%.

Combining the estimated rates from area I and II weighted by catch distribution (0.6 area II and 0.4 other areas), the estimated overall herring incidence rate for the eastern Bering Sea was 0.136% during 1978-79 herring year. Similarly, the rate was 0.125% in 1980 and .04% in 1981. The average for the three-year period is 0.10%. The incidence rate used to calculate the AIC and PSC is therefore established as 0.10%.

The maximum expected Bering Sea groundfish OY is 2.0 million mt. Thus, the maximum expected combined AIC and PSC is 2,000 mt. In 1982 the calculated combined AIC and PSC would have been approximately 1,400 mt.

8.3.1.2 Apportionment of AIC

AIC is a part of the OY for the herring resources. AIC is equal to the incidence rate (0.10%) times the domestic groundfish allocation. It is automatically apportioned with and inseparable from groundfish DAH. If the

8.3.1.5 Exemptions

The Herring Savings Area applies to trawl gear only. Longline, pot or other gear which are not utilized to fish for herring or catch herring above trace amounts (less than 0.001% of total catch) are exempt from this time/area restriction.

8.3.2 Herring Savings Area

As was noted above, prior to 1982 the majority of trawl-caught herring was taken in U.S. Statistical Area II and only a small amount was taken in other areas of the eastern Bering Sea. The Council compared four options in determining which areas should be closed to protect herring. The four options are shown in Figure 8-1, and relative area comparisons are shown in Figure 8-2.

To compare the effectiveness of each closure for herring protection, data supplied to the U.S. by Japan were used. The Japanese data cover the years 1968 through 1978 and contain catches by species, month, 1° longitude by ½° latitude, and vessel class. Comparable data are not available from the Soviet fishery; therefore, it must be assumed that they operated in the same areas as the Japanese. U.S. surveillance reports indicate that the Japanese and Soviet herring fisheries did operate in the same general area, (see Tables 8-1, 8-2 & 8-3).

Area selection was based on the years 1968 and 1972. These years were selected because catches were high and most herring were taken as the target species. Also during these years, there were no catch quotas or regulations that would have influenced fishing. In subsequent years, catches have been low, influenced by declining stocks or quotas and regulations. The boundaries of the potential closure areas follow lines of latitude and longitude as much as possible to minimize future enforcement efforts, although, by doing so, some blocks are included in which herring have not been caught.

Table 8-4 contains the catch of herring within each area for the November-March period that the closures would be in effect, total Bering Sea herring catch for gear other than gillnet for the November-March period, and the

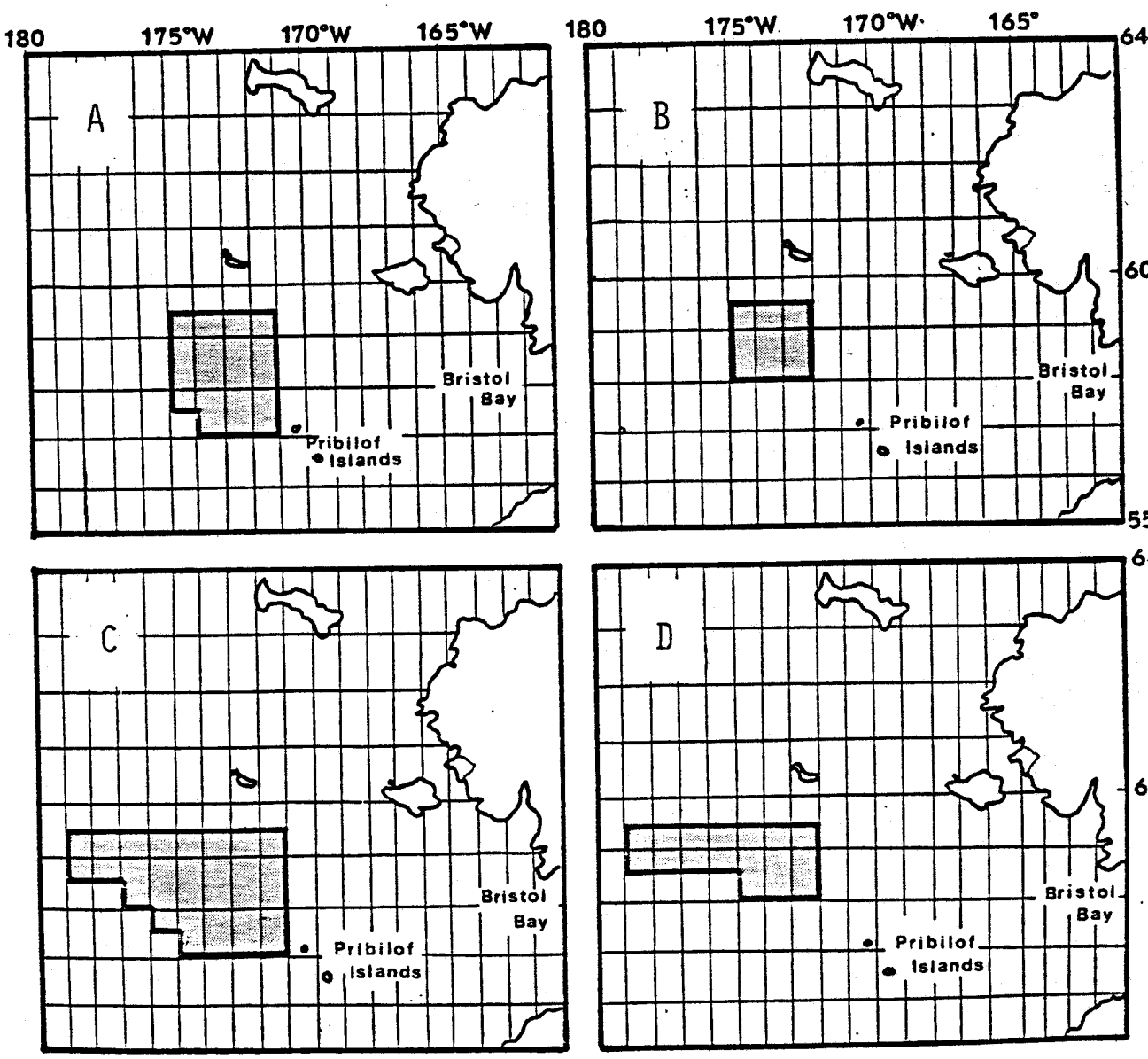

Figure 8-1. Options considered for the Herring Savings Area. Area C provides the maximum protection to the wintering herring populations.

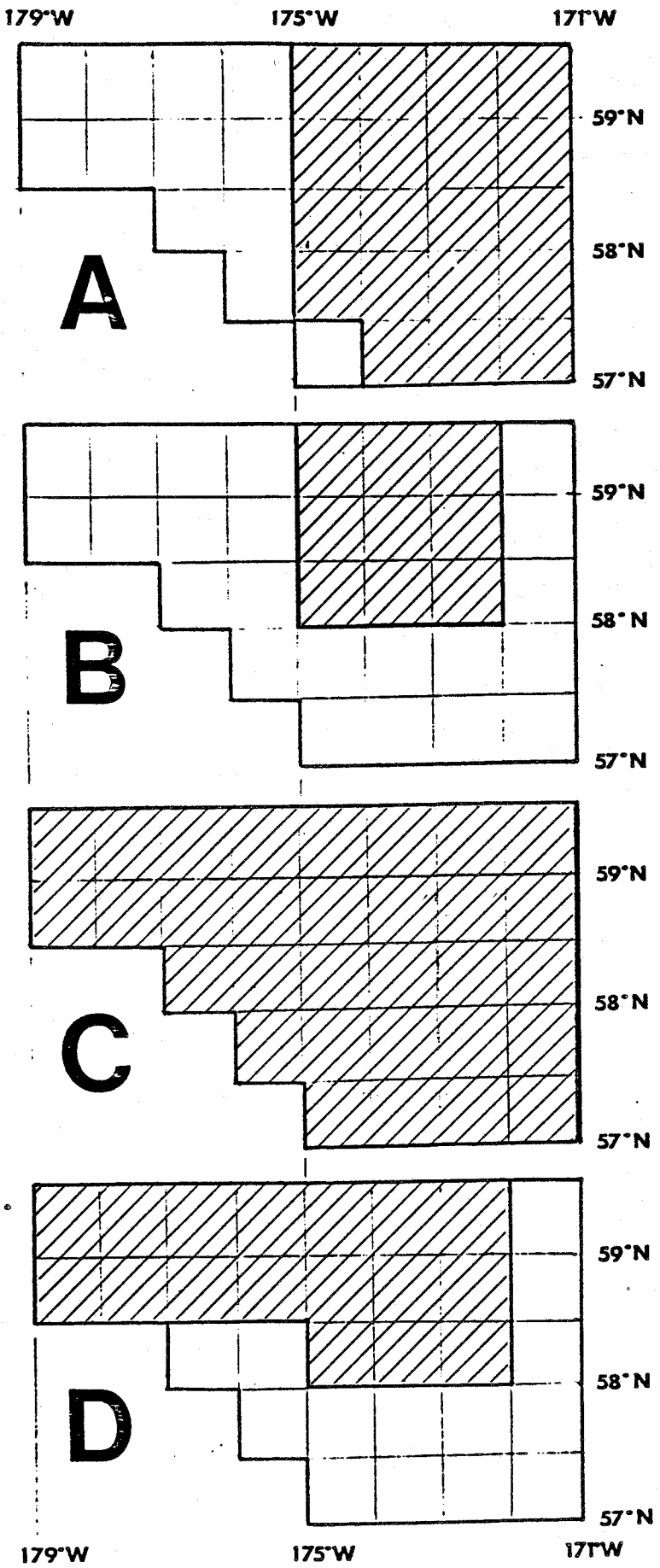

Figure 8-2. Herring savings area options = Relative area comparisons.

Table 8-4. Japanese herring catch in the proposed November-March time-area closures and the eastern Bering Sea and the mean catch and mean percentage of the Bering Sea annual and November-March catch for the years 1968-69 to 1971-72 and 1968-69 to 1977-78.

	Herring Catch (mt) by Area					
					Bering Sea	
	A	B	C	D	Nov.-March	Annual (Jul.-June)
1968-69	40316	40273	40479	40436	41875	50857
69-70	20925	17045	21085	17165	22274	23901
70-71	19415	19298	22978	22737	23717	24236
71-72	12301	11748	12534	11978	12889	13143
72-73	18	18	18	18	435	346
73-74	21	14	94	91	620	219
74-75	17	16	124	115	1569	2663
75-76	5	0	296	291	612	3119
76-77	4929	4858	8428	7873	12127	13413
77-78	4	5	431	375	1257	2703
Mean Catch:						
1968-69 to 71-72	23240	22091	24269	23581	25118	28034
1968-69 to 77-78	9795	9327	10647	10109	11737	13460
Mean(%) of Bering Sea November-March Catch:						
1968-72	93	88	97	94		
1968-78	84	80	91	86		
Mean(%) of Bering Sea Annual Catch:						
1968-72	83	79	86	84	90	
1968-78	73	69	79	75	87	

annual herring catch for the year 1968-1969 and 1977-1978. Mean catches were computed for the entire data series and for the year 1968-1969 to 1971-1972. The latter series is believed to be more indicative of the amount of protection to herring stocks by each time-area closure, because in these years stocks were high, regulations did not exist, and herring was a target species to a greater degree than in later years.

The 1968-1969 to 1971-1972 data show that 90% of the Bering Sea herring catch occurs from November-March and that 88-95% of this catch is taken within the proposed herring time-area closure. Area C (the largest area) provides the greatest protection, accounting for 95% of the average November-March catch and 85% of the average annual catch. Area B (the smallest area) provides the least protection, accounting for 88% of the November-March catch and 79% of the average annual catch. The other two areas (A and D) are intermediate to B and C and account for 93% and 94% of the average November-March catch and 83% of the average annual catch, respectively.

The difference in herring protection afforded by the four areas is nonsignificant because of the variability in distribution of herring over the past years (1968 to 1978). Historically, the greatest proportion of herring harvest has been in Area B, the smallest area. However, there are significant differences in relation to the proportion of total groundfish catch and pollock in particular taken in these areas.

Table 8-5 shows that the November-March Bering Sea groundfish harvest averaged 16.5% of the annual harvest. The proportion of the winter harvest taken in the proposed time-area closures ranges from 24.3% in Area C to 6.3% in Area B. In relation to the Bering Sea annual harvest, the proportion harvested in the time-area closure ranges from 1% to 4%.

The pollock catch record is more meaningful than the total groundfish harvest, because it is the principle target species in the area proposed. Pollock comprised 77% of the average November-March Bering Sea catch, and pollock and herring combined averaged 83% of the Bering Sea winter groundfish harvest from 1968-1969 to 1977-1978.

Table 8-5. Japanese total groundfish (including herring) catch in the proposed November-March time-area closures and the eastern Bering Sea and the mean catch and percentage of the Bering Sea annual and November-March catch for 1968-69 to 1977-78.

	Groundfish Catch (1000 mt) by Area					
					Bering Sea	
	A	B	C	D	Nov.-March	Annual
1968-69	44.5	44.4	44.7	44.6	160.0	878
69-70	31.3	20.7	32.5	20.9	180.4	1036
70-71	38.1	24.5	42.8	28.6	264.1	1447
71-72	34.2	16.7	53.6	34.2	305.3	1782
72-73	14.9	6.6	44.1	29.2	257.7	1844
73-74	6.6	6.7	109.1	95.2	245.0	1726
74-75	21.2	4.9	62.0	37.4	191.7	1487
75-76	14.0	0.8	32.2	13.2	297.1	1278
76-77	18.9	13.3	52.0	41.6	157.8	1062
77-78	2.7	1.2	69.4	57.2	174.1	957
Mean Catch:	22.6	14.0	54.2	40.2	223.3	1350
Mean (%) of Bering Sea November-March Catch:	10.1	6.3	24.3	18.0		
Mean (%) of Bering Sea Annual Catch:	1.7	1.0	4.0	3.0	16.5	

The relationship of harvest between areas is the same for pollock as for groundfish, but the percentage of catch drops sharply in Areas A and B, primarily because herring, included in the total grounfish catch, was the major species, along with pollock, harvested in these areas. If a time-area closure is instituted, the greatest impact to existing fisheries would be in Area C which averaged 21.4% of the November-March catch during the period of record (Table 8-6). Area B would have the least impact with 1.8% of the November-March average pollock harvest, and Areas A and D are intermediate with averages of 5.7% and 15.7%, respectively. On an annual basis institution of an Area A closure would result in an average of a 0.8% reduction of the Japanese pollock harvest, 0.3% with Area B, 3.2% with area C, and 2.3% with Area D.

This analysis is based on Japanese data, and measures impact to Japanese fisheries only. The U.S.S.R. has also conducted a major fishery in the Areas analyzed. U.S. observer data and historical catch data show that much of the Soviet effort in these areas has been directed toward herring and that the ratio of herring to pollock and groundfish is much higher than for Japan. Therefore, if U.S.S.R. data had been available, the amount of herring protection would have been greater in each area and the overall impact to other fisheries would have been less.

Historically, Area B has contained the bulk of the herring found on the winter grounds. However, in the late 1970s, in response to different hydrological conditions, herring winter distribution shifted to the northwest corner of Area C. Since herring are known to winter in different locales over a large range and since it may be difficult to determine the specific area, it is prudent to select Area C, which covers most of the winter range, as the primary area closure for the November-March period.

At the time AIC or PSC is attained the Regional Director will, using field order authority close the entire area or only the portion of Area C necessary to protect herring in a particular season using criteria specified under Section 12.5. If it occurs that AIC or PSC is exceeded prior to November or the amount remaining is so small that it could be exceeded within one reporting period (one week) prior to November and the specific wintering

Table 8-6. Japanese pollock catch in the proposed November-March time-area closures and the Eastern Bering Sea and the mean catch and percentage of the Bering Sea annual and November-March catch for 1968-69 to 1977-78.

	Pollock Catch (mt) by Area				Bering Sea	
	A	B	C	D	Nov.-March (1000 mt)	Annual (1000 mt)
1968-69	3317	3270	3364	3317	97.9	701
69-70	2416	592	2471	591	122.2	830
70-71	11601	1322	11655	1337	187.2	1231
71-72	18417	4598	35505	20348	242.6	1513
72-73	12820	5715	40089	26988	214.2	1651
73-74	5889	5191	102438	90713	201.7	1476
74-75	18923	4468	46942	34768	157.4	1253
75-76	11106	660	26103	11104	246.4	1137
76-77	10258	1156	37102	28586	113.9	913
77-78	2478	3483	60495	51011	125.1	869
Mean Catch:	9723	3046	36616	26876	170.9	1158
Mean (%) of Bering Sea November-March Catch:	5.7	1.8	21.4	15.7		
Mean (%) of Bering Sea Annual Catch:	0.8	0.3	3.2	2.3	14.8	

location of the herring population in that season cannot yet be determined, then that portion of Area C corresponding to Area A should be closed beginning October 1. In November the Regional Director should reevaluate the closure and adjust as necessary to protect herring. This closure under the above set of conditions was selected because it provides the greatest savings of herring and the least impact to the groundfish fishery based on the available data.

Since the primary purpose of the Herring Savings Area is to protect herring on the winter range, once closed to a nation, the Herring Savings Area should remain closed until April 1. At any time the Regional Director may reevaluate the closure using the criteria specified under Section 12.5.

8.4 Limited Entry

The Bristol Bay herring roe fishery is the only major herring fishery in Alaska which is not covered by a limited entry system. As the fishery develops and effort increases, management problems may arise and create a need for imposing limited entry. Once a need is perceived, entry into the inshore roe fishery will be regulated by the Alaska Commmerical Fisheries Entry Commission.

If an intensive high seas domestic herring fishery eventually develops, entry to this fishery could be regulated through an amendment to this FMP.

8.5 Offshore Petroleum Production

Most of the Bering and Chukchi Seas are scheduled for sale under the current five-year Outer Continental Shelf (OCS) Oil and Gas Leasing Schedule (Figure 8-3). Both the St. George Basin sale and the Norton Basin sale have already taken place but are being delayed by court actions. Further sales in these areas are scheduled in 1984, 1985 and 1986. Navarin Basin sales are scheduled for 1984 and 1986; Barrow Arch sales are scheduled for 1985 and 1987; and North Aleutian Basin sales are scheduled for 1985.

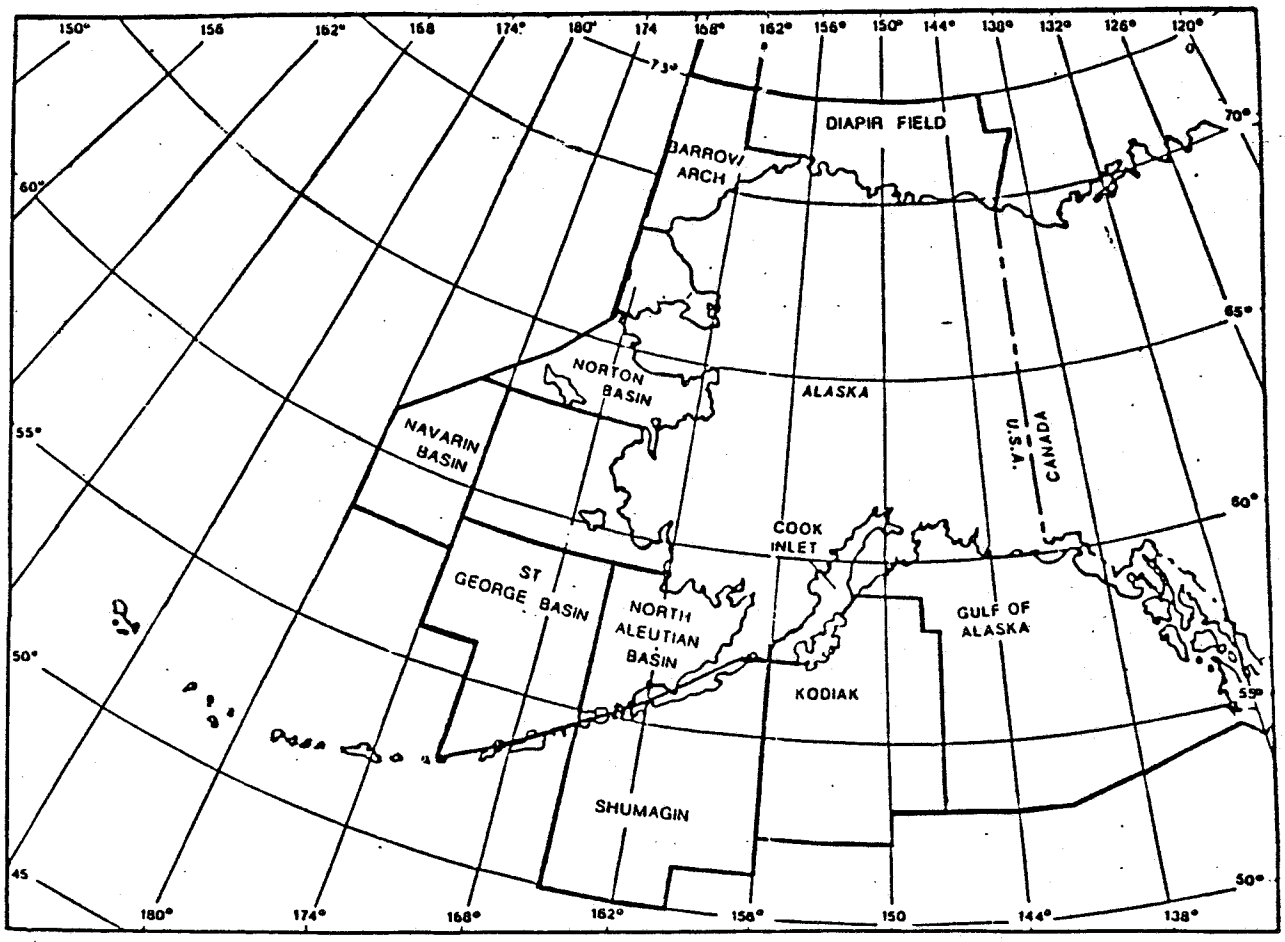

Figure 8-3. Proposed lease areas for oil and gas development.

Several potential conflicts could arise between oil development and the herring resource. Because Bering Sea herring spawn primarily in intertidal areas, herring eggs would be particularly vulnerable to surface oil film. Research to quantify this potential impact, as well as the impact of oil on rockweed kelp (Fucus) should precede lease sales in the area. Habitat alterations to include disposal of drilling muds and cuttings, pipeline excavation, dredging, and improper waste disposal could all directly or indirectly impact the herring resource. Potential impacts on the herring fishery include preemption of fishing areas as the result of the presence of platforms, pipelines, and offshore terminals; navigational hazards of such facilities as well as the anticipated large increase in vessel traffic; bottom obstruction such as unburied pipelines, well head stubs and debris; oil fouling of fishing gear; and tainting of fishery products.

9.0 CATCH AND CAPACITY DESCRIPTORS

The current harvest of herring takes place primarily within state waters although interest has been shown by domestic fishermen in the establishment of an offshore herring fishery. These primary fisheries are described below.

9.1 Subsistence Fishery

Herring are currently utilized by residents in many coastal communities throughout the region and subsistence harvests vary considerably by location. Herring are more important as a subsistence item to residents in the Yukon-Kuskokwim Delta with the greatest utilization occurring in the Nelson Island area. The greater dependency of Nelson Island residents is the result of several factors including the availability of herring, the absence or low abundance of alternative food resources (salmon, moose, etc.) and few employment opportunities.

During the period 1975-82, the subsistence harvest of herring along the Bering Sea coast averaged approximately 100 mt annually (see Section 3.1.3). While there is a potential for increased subsistence harvests because of the greater abundance of herring in recent years, this is not expected to occur. Harvests of approximately 100 mt appear adequate to meet the needs of subsistence users of herring. Therefore the expected catch of subsistence fishery is estimated to be 100 mt. It must be noted that this is not a quota.

A priority of this FMP is to maintain the stocks which support subsistence harvests at a level which will allow continuation of subsistence harvesting in a traditional manner.

9.2 Togiak Roe Fishery

Although the roe fishery in Bristol Bay (i.e., the Togiak district) has a relatively short history, the harvesting and processing capacities can be reasonably estimated. In 1980 a total of 140 purse seine vessels and 363 gillnet vessels took part in the inshore fishery, while 27 buyers processed the catch. The total Togiak catch was approximately 23,000 mt. Of this

total, 5,200 mt was dumped due to low quality, leaving 17,774 mt which was processed by domestic processors. In 1982 19,556 mt was harvested by 135 purse seine and 200 gillnet vessels. Reports on the fishing grounds indicated harvest capacity was considerably greater and many vessels did not meet their harvest expectations. Domestic processing vessels approached their capacities during the peak of the harvest, but many considered their capacity was temporarily reduced due to machinery failures and unfamiliar processing techniques. During the 1982 season, for the first time, the majority of the domestic harvest was frozen, and some processors were still developing the equipment and techniques to freeze large volumes of herring.

For the first time in 1982, the governor of Alaska invited certain foreign vessels to enter state waters to process a portion of the domestic gillnet harvest. Gillnetters had complained in the past that some U.S. processors either would not purchase or offered lower prices for gillnet-caught herring. Prior to the 1983 season Alaska again made arrangements for vessels of the Japanese Longline and Gillnet Association to process a portion of the gillnet harvest.

Both harvesting and processing capacities are determined partly by pre-season estimates of the herring run and predicted market price, and partly by weather. In 1979 there were 175 purse seine vessels present on the grounds, and in 1980 there were 363 gillnet vessels present. The 1979 domestic processing capacity was estimated at more than 36,400 mt, which exceeds the largest catch to date by more than 50%. It can be expected, however, that market price, weather, ice condition, unusual run timing or other factors will occasionally disrupt the normal or predicted inshore harvest patterns.

9.3 Roe Fishery North of Cape Newenham

The roe fishery north of Cape Newenham is less developed than the Togiak fishery. Large-scale processing capacity was available for the first time in 1979. The 1980 season yielded a total catch of 3,787 mt, which was more than double the harvest in 1979. In 1981 the total catch reached 6,278 mt and in 1982 was 5,341 mt.

9.4 Summer Food and Bait Fishery

From 1929 through 1938 a sustained harvest of approximately 1,000-2,000 mt annually in the Dutch Harbor area in the Aleutian Islands took place. The demise of the 1930's fishery resulted from changing market conditions and the last significant harvest in the Dutch Harbor/Unalaska Islands area occurred in 1945. Smaller harvests have occurred throughout the region as developing crab fisheries placed a premium on fresh bait.

In 1981 the eastern Aleutians herring food/bait fishery began to re-develop and a harvest of 639 mt was taken. A growing interest among local processors and fishermen, and a very favorable market response to the final food and bait products, lead to a 1982 harvest of 3,234 mt. The majority of the catch came from Unalaska Bay which is within 2-3 hours of the major processing ports. To date this harvest has been exclusively by seine vessels in state waters, although regulations allow fishing with other gear types and in other areas.

9.5 Domestic Winter Food Fishery

The domestic groundfish fishing industry has expressed considerable interest in an offshore herring fishery, and it may be anticipated that should a winter apportionment of OY be available, a winter offshore herring fishery will commence. It is expected that a high seas herring fishery would be conducted by trawl vessels engaged primarily in fisheries for various species of groundfish. Many trawlers and multipurpose vessels now engaged in the king crab fishery are seeking alternative or supplementary fishing opportunities. Thus, it is expected that domestic groundfish fishing capacity is indicative of domestic offshore herring fishing capacity.

A conservative projection of the domestic harvest of groundfish in the Bering Sea/Aleutian Islands area for 1982 is 125,000 mt; it is estimated that by 1986 this domestic harvest could reach 470,000 mt. Domestic groundfish processing capacity in the area for 1982 is conservatively estimated at 25,000 mt, and could reach 70,000 mt by 1986.

9.6 Joint Venture Winter Food Fishery

A joint venture groundfish operation between United States fishermen and a Soviet processing vessel was started in the spring of 1980 and an allocation of 4,900 mt of herring was made. In a "joint venture" operation, United States fishermen deliver their catches at sea to foreign processing vessels. The 1980 fishery was terminated on February 7, 1980 by a court order based on procedural defects in the rulemaking process. Prior to that time, the catch was limited to 36.9 mt due to heavy icing and adverse conditions. It is evident that the harvesting of herring in the offshore waters by domestic fishermen can be successful in conjunction with a floating processor. However, high seas domestic floating processor capability for herring has yet to be demonstrated. A joint venture processing (JVP) component of DAH can be allowed only if domestic processors will not utilize the fish proposed to be taken by the United States fishermen. If the surplus is available, it is highly probable that a joint venture operation would be formed to take the allowed allocation. Joint venture groundfish processing capacity in the area for 1982 is conservatively estimated at 100,000 mt, and could reach 400,000 mt by 1986. A determination will be made each year of JVP given available surplus yield.

9.7 Determination of Domestic Annual Harvest

Although the extent to which domestic groundfish processors intend to process herring for food is not clear, domestic harvesters and joint venture processors have expressed a strong interest in harvesting and processing any winter apportionment of OY. It is clear that they have the capacity to do so, and therefore DAH shall be equal to OY.

10.0 OPTIMUM YIELD

OY shall be the sum of three components: an AIC apportionment of OY, a summer apportionment of OY, and a winter apportionment of OY. These three components shall be determined as follows:

10.1 AIC Apportionment of OY

The AIC apportionment of OY shall be 0.10% of the domestic groundfish allocation as determined through the FMP for Groundfish in the Bering Sea/ Aleutian Islands Area. AIC is automatically apportioned with and inseparable from the groundfish DAH, and it is available for harvest throughout the calendar year and throughout the management unit where another apportionment of OY is not available. Any portion of this AIC which is not harvested shall not be reallocated. Because AIC is part of OY it may be retained. This AIC apportionment shall not be reduced.

AIC is apportioned for the herring fishing year. Thus, once AIC is reached herring becomes a prohibited species.

10.2 Summer Apportionment of OY

The summer apportionment of OY shall be 2,000 mt, and shall be available for harvest south of 55°47'N latitude during the period of July 1 through September 30. In order to assure that this summer apportionment of OY does not cause the fishery to exceed historic levels, harvests in the inshore (territorial sea) fishery south of 55°47'N latitude from July 1 through September 30 shall be counted against the achievement of the 2,000 mt summer apportionment of OY. When 2,000 mt has been harvested in the FCZ and the territorial sea taken together, the FCZ south of 55°47'N latitude shall be closed to fishing for herring until the next apportionment is made.

The summer apportionment of OY may be reduced if NMFS, in consultation with the Council and the State, finds a serious problem resulting from any of the following factors:

(a) Extent to which the subsistence and inshore commercial fisheries harvested or overharvested the ABC.
(b) Condition of the spawning stocks of herring with special focus on the subsistence stocks.
(c) Abundance of spawning herring and their spawning success.
(d) Age composition of the spawning herring.
(e) Recruitment to the spawning stocks of herring.
(f) Variation in exploitation rates between the spawning stocks.
(g) Changes in the State's management of the inshore commercial fishery.

10.3 Winter Apportionment of OY

The winter apportionment of OY shall be determined as follows:

Winter Apportionment of OY = ABC - Inshore Commercial Harvest
subsistence adjustment - (AIC + PSC)

In the event that the winter apportionment of OY as calculated is less than zero, the winter apportionment of OY shall be set equal to zero.

The winter apportionment of OY is further reduced by 50%. This reduction of the winter apportionment of OY is due to the social and economic importance of the subsistence and inshore commercial fisheries. This reduction insures that the winter apportionmnent of OY will remain conservative to protect these priority fisheries. The Council will review this procedure for determining the winter apportionment of OY within three years after the implementation of this plan.

The winter apportionment of OY shall be available for harvest throughout the management unit from October 1 (or the date which notice of its determination is filed with the Federal Register, whichever comes later) until March 31, the end of the fishing year.

10.3.1 Inshore commercial harvest

The inshore commercial harvest shall be the total harvest taken from State waters between April 1 and September 30 and from the FCZ directed harvest between July 1 and September 30.

10.3.2 Subsistence adjustment

The subsistence harvest of herring has been identified as a priority fishery by both the State of Alaska and the Council (see Section 3). The majority of this harvest takes place in the Nelson Island area. These stocks have already been provided an additional degree of protection by the exclusion of those stocks from the spawning biomass estimates. But it is noted that subsistence harvest of herring does occur elsewhere in the management area. To insure protection of all subsistence fisheries, 500 mt is subtracted in the determination of the winter apportionment of OY in order to provide an additional degree of protection for all subsistence stocks.

10.3.3 AIC/PSC

An incidental catch in the groundfish trawl fishery is subtracted in the determination of the winter apportionment of OY. The value to be subtracted will be the number determined for the current year as described in Section 8.3 and will be equal to the sum of AIC and PSC.

10.3.4 Limitation of winter apportionment of OY

This apportionment shall be further limited as follows:

(a) If the amount so calculated is less than 2,000 mt, the winter apportionment of OY shall be zero. This limitation is to insure that any winter appropriation of OY will be large enough to insure that a directed herring fishery is undertaken, not just an increase of the incidental harvest in the groundfish fishery. Also, this will prevent the catch from exceeding the allowable level within one reporting period.

(b) If the current herring spawning biomass is less than one-half of the MSY biomass, the winter apportionment of OY shall be zero. This limitation is to insure that at times of low spawning biomass rebuilding of stocks is placed in higher priority than the offshore fishery.

(c) If the amount so calculated is greater than 10,000 mt, then the winter apportionment of OY shall be 10,000 mt. This limitation is to insure that any offshore fishing which is authorized is controlled in its development. The Council does not feel in light of the priorities for other fisheries established in this plan and the status of the resource that a winter apportionment of OY will be available in every year, and therefore the Council does not wish to encourage an offshore fishery to develop which is dependent upon this allocation.

The winter apportionment of OY as calculated may be further reduced by the Council or the Regional Director, in consultation with the State, if either finds a serious problem resulting from any of the following factors.

(a) Extent to which the subsistence and inshore commercial fisheries harvested or overharvested the ABC.
(b) Condition of the spawning stocks of herring with special focus on the subsistence stocks.
(c) Abundance of spawning herring and their spawning success.
(d) Age composition of the spawning herring.
(e) Recruitment to the spawning stocks of herring.
(f) Variation in exploitation rates among the spawning stocks.

10.4 Determination of OY

Prior to January 1 the Council will determine the value for the AIC apportionment of OY, which shall be available for harvest beginning April 1. Upon the estimation of ABC by the Regional Director of the NMFS, the Council shall develop and make available recommended values for the remaining components of OY. The summer apportionment of OY shall be made immediately available for harvest. The Council shall provide for public comments on the estimated

winter apportionment of OY. The Council shall by October 1 recommend a final value of the winter apportionment of OY to the Assistant Administrator or the Alaska Regional Director, NMFS, who will specify the final values.

11.0 TOTAL ALLOWABLE LEVEL OF FOREIGN FISHING

Total Allowable Level of Foreign Fishing (TALFF) shall be equal to zero.

The maximum allowable summer offshore harvest is 2,000 mt. The 1982 food and bait harvest in the territorial sea along the Aleutian Islands south of 55°47'N latitude was 3,234 mt. The maximum allowable winter offshore harvest is 10,000 mt. Groundfish harvesting and processing capacities are indicative of capacity to harvest and process herring. A conservative projection of the domestic harvest of groundfish in the Bering Sea/Aleutian Islands area for 1982 is 125,000 mt; it is estimated that by 1986 this domestic harvest could reach 470,000 mt. Domestic groundfish processing capacity in the area for 1982 is conservatively estimated at 25,000 mt, and could reach 70,000 mt by 1986. Joint venture processing capacity in the area for 1982 is conservatively estimated at 100,000 mt, and could reach 400,000 mt by 1986. Although the extent to which domestic groundfish processors intend to process herring for food is not clear, domestic harvesters and joint venture processors have expressed a strong interest in harvesting and processing any winter apportionment. It is clear that they have the capacity to do so, and that no portion of the OY will be available for foreign harvest.

12.0 MANAGEMENT SYSTEM

This section prescribes the management regime for herring fishing operations in the FCZ of the Bering/Chukchi Sea. The subsistence and inshore commercial fisheries described in this plan will continue to be managed by the State of Alaska and are beyond the scope of this FMP and this management regime.

12.1 Objectives

This FMP has been prepared in accordance with the National Standards set forth in Section 301(a) of the Magnuson Act.

The Council has determined that the priorities for fisheries which utilize the herring stocks which are covered by this plan are as follows:

(1) subsistence fishery
(2) inshore commercial fisheries
(3) offshore domestic fisheries

Based upon these priorities, the following specific objectives have been developed.

(1) To conduct any harvest of herring in the FCZ in such a manner to insure:

   a. Maintenance of the herring resource at a spawning level that will provide the maximum production of recruits.
   b. Maintenance of the subsistence herring stocks and the subsistence fishery.
   c. Maintenance of the herring resource at a level that will sustain populations of predatory fish, birds and mammals.
   d. Development and maintenance of the inshore commercial fisheries.

(2) Consistent with objective 1, promote full utilization of the herring resources by domestic offshore fisheries.

(3) Provide to the extent possible a unified management regime between federal and state jurisdictions.

It is recognized that to achieve these objectives on a long-term basis it will be necessary to establish a conservative management regime for the near future. The rationale for support of a conservative management regime is that the abundance of herring declined sharply in the early 1970s and only recently has an increase become apparent. Although several hypotheses could be advanced to explain the cause of the observed decline, data are insufficient to establish conclusively a causal factor. Also, present knowledge of the resource is redimentary and inferences on many aspects of life history must be drawn from other more thoroughly studied populations. Since rapid, marked changes in abundance are expected to occur in the future, based on historic patterns in world herring fisheries, and as management and research are at an embryonic stage, it is prudent to manage the resource conservatively until basic management data become available.

Justification and Rationale for Objectives

Objective 1 recognizes the importance and priority established for the subsistence and inshore commercial fisheries. The objective is to insure that any harvest in the FCZ recognizes the importance of these other fisheries and of the herring resource to the Bering Sea ecosystem.

Herring managers world-wide have recognized the importance of maintaining a strong spawning biomass. In the North Atlantic Ocean, management is based on setting yield at or below the $F_{0.1}$ level (see Section 7.6.2) to maintain a sufficiently large multi-age spawning biomass. In British Columbia, management is based on escapement where the fish surplus to spawning requirements are allocated to the fishery on data that egg survival is greatest at moderate densities and a maximum number survive to the critical larval stage.

At present, data are insufficient to determine the level of biomass that will produce maximum recruitment, however, assuming that MSY is an indicator of long-term average yield achievable at an exploitation rate of 20%, then at least average recruitment should be maintained at this biomass level.

Subsistence activities play a major role in the economics of the Bering Sea region of Alaska. The rural economy of the area is best described as a mixed catch/subsistence economy, and in the Nelson Island area herring play a greater than average role in local villages due to the lack of alternative food items. In general, the fishing gear and techniques of subsistence fishermen are less efficient than those of commercial fishermen which results in the need for a greater abundance and availability of herring to ensure adequate harvest.

The FMP recognizes the importance of herring to subsistence users and places a high priority on the subsistence stock and subsistence fishery. The management measures proposed reflect the need to protect this priority utilization.

Maintenance of the resource at a level that will sustain populations of predatory fish, birds and mammals is met since resource surveys will be conducted annually and deviation about the mean biomass level reflects changes in the survival of herring year-classes of which predation is a major component. If a strong predatory-prey relationship exists between herring and a mammal, bird or fish species, then managing herring to dampen strong stock fluctuations should also dampen fluctuations in the predatory species. Also, limiting yields to or below the $F_{0.1}$ level should insure an adequate amount of herring for use by other species.

Development and maintenance of the inshore commercial fisheries is insured by the higher priority placed upon these fisheries and by the limitation placed upon the development of the offshore commercial fisheries.

Objective 2 recognizes that need to promote the full utilization of the herring resources within the limits expressed in the prioritites and concerns of Objective 1. This objective is met to the degree possible by the plan through the formulation and allocation of optimum yield.

Objective 3 recognizes the need for cooperative management of these resources between the Council and the State. This objective is met by insuring that management actions which would affect the state's management activities are coordinated with the state and that the state is consulted on matters pertaining to the conservation of the resource.

12.2 Allocations to the fisheries

12.2.1 Fishing year

The fishing year shall be April 1 to March 31.

A fishing year commencing April 1 coincides with the migration of herring into coastal waters for spawning and is a natural division between the fisheries occurring on the winter grounds and those on the spawning grounds.

12.2.2 AIC Apportionment of OY

The AIC apportionment of OY shall be 0.10% of the domestic groundfish allocation as determined through the FMP for Groundfish in the Bering Sea/ Aleutian Islands Area. AIC is automatically apportioned with and inseparable from the groundfish DAH, and it is available for harvest throughout the herring fishing year and throughout the management unit where another apportionment of OY is not available. Any portion of this AIC which is not harvested shall not be reallocated. Because AIC is part of OY it may be retained.

AIC is apportioned on April 1 for the fishing year.

12.2.3 Summer apportionment of OY

Two thousand mt of herring is apportioned to the offshore summer food and bait fishery of the Aleutian Islands/Alaska Peninsula area. This apportionment shall be harvested only south of 55°47'N latitude, during the period July 1 through September 30. In order to assure that the summer apportionment of OY does not cause the fishery to exceed historic levels, harvests in the inshore (territorial sea) fishery south of 55°47'N latitude from July 1 through September 30 shall be counted against the achievement of the summer apportionment of OY. When 2,000 mt has been harvested in the FCZ and the territorial sea taken together, the FCZ south of 55°47'N latitude shall be closed to fishing for herring until the next apportinment is made.

12.2.4 Winter apportionment of OY

Any winter apportionment of OY determined by the method established under Section 10.2 of this plan shall be made available to the domestic offshore fishery starting October 1 (or the date which notice of its determination is filed with the Federal Register, whichever comes later) and will be available until March 31.

12.3 Management Measures and Rationale for Domestic Fisheries

12.3.1 Inshore commercial fisheries

Regulations for the orderly conduct of the inshore commercial fisheries are promulgated by the State of Alaska.

12.3.2 Offshore commercial fisheries

i. Provisions for allocation, see subsections 12.2.2, 12.2.3.

ii. The FCZ will be closed to directed fishing for herring from the beginning of the fishing year, April 1, until July 1, south of 55°47'N latitude. North of 55°47'N latitude the FCZ will be closed to directed fishing for herring from April 1 to September 30 or the date on which notice of the winter apportionment of OY is filed with the Federal Register (whichever comes later). In the event the winter apportionment of OY is zero, the total management area is closed to directed herring fishing from October 1 to March 31.

Rationale

The FCZ closure from April 1 to July 1 prevents interception of roe-bearing fish during the spawning period. The July 1 opening south of 55°47'N allows continuation of the summer fishery which has developed in the Aleutians. The July 1 opening date allows fishing during a time when there is a likelihood that local stocks are present in this fishing area.

The 55°47'N boundary does not restrict fishermen from traditional summer fishing areas. This particular boundary is identical to the current boundary established by State of Alaska regulation, and will thus help reduce potential conflict.

The winter offshore fishery has historically occurred in October through March. Any winter apportionment of OY will be made as early as possible to allow this fishery to proceed as usual.

iii. All or part of the Herring Savings Area as described in Section 8.3 will be closed to domestic herring and groundfish trawl fisheries by the Regional Director, if:

(a) the total DAH (including AIC) has been harvested; or
(b) the amount of remaining AIC can be harvested within one reporting period (one week).

Any closure of the Herring Savings Area will occur only between September 30 and April 1. Once closed the Herring Savings Area or any portion of it shall remain closed until April 1.

Rationale

The Herring Savings Area is designed to protect the feeding stocks against further harvest by the winter fisheries. Closing this area when DAH (including AIC) has been reached will prevent groundfish operations in areas of high herring abundance.

iv. All herring caught in an area open to directed herring fishing will be charged against the summer or winter apportionment of OY, whichever is currently available. All herring harvested in an area closed to directed herring fishing will be charged against AIC.

Rationale

This procedure simplifies the accounting of AIC.

v. When the domestic AIC has been used herring becomes a prohibited species throughout the management unit until April 1, and may not be retained.

Rationale

Herring are utilized primarily in inshore fisheries and the probability of serious negative impacts by offshore fisheries should be minimized. After DAH (including AIC) has been harvested there is still a need to protect the herring stocks. Making herring a prohibited species at this point will prevent any targeting on herring and will simplify enforcement of the conservation program.

vi. This closure applies to trawl gear only.

Rationale

Trawl gear has historically had the greatest impact on herring stocks in the FCZ. Longline, pot and other gear which does not harvest herring to any significant degree are therefore exempted from the herring savings area closure.

12.3.3 Other regulations

Regulations in the Bering Sea/Aleutian Islands Groundfish FMP for time and are closures shall also apply to all offshore herring fisheries.

Rationale

Any herring trawl fishery in the FCZ will most likely be conducted in conjunction with domestic groundfish fisheries. The restrictions on groundfish fishing operations have been developed to protect incidentally caught species and prevent gear conflicts. As herring fishing gear is similar to groundfish fishing gear (e.g. pollock), the herring fishery has potentially the same impact. Thus, the Bering Sea Groundfish FMP implementing regulations specifying time and area closures shall also apply to the herring fisheries to minimize adverse impacts and to maintain consistency of regulations.

12.3.4 Statistical reporting requirements

All necessary information regarding inshore harvest and processing can be obtained from the State of Alaska. U.S. fishermen fishing in the FCZ and not landing their catches on shore are currently not required to report their catches to either state or federal authorities. Due to the vast area of the FCZ which may be opened to herring fishing and the unknown distribution and composition of offshore stocks, it is critical that the FMP provide for collection of harvest information. The need for this information increases with the magnitude of the offshore catch -- if the FCZ harvest is small only total catch and general area information may be required. However, due to the lack of definitive data and uncertain impacts of mixed-stock offshore fishing, much more detailed information would be required for managing a major FCZ fishery. Without an adequate information collection mechanism, a major fishery could cause irreparable damage and should not be allowed. The type of information for management of an FCZ herring fishery includes catch, time, area and effort. Non-fishing "search" time might also be critical for detection of stock declines. Specifically, where information is not available from other sources, this FMP authorizes collection of the following statistics from vessels harvesting herring in the FCZ:

(1) catches reported by ½ degree latitude x 1 degree longitude areas; and

(2) effort reported by gear type and vessel class by month. Examples of effort data include hours towed, number of landings, and number of trips.

12.3.5 Permit requirements

All U.S. vessels operating in the FCZ portion of the Bering/Chukchi Sea must have on board a permit issued by the Secretary of Commerce.

12.4 Management Measures and Rationale for the Foreign Fishery

12.4.1 Herring fishing or retention of herring prohibited

i. Directed fishing for or retention of herring is not allowed within the management unit.

ii. All or part of the Herring Savings Area, as described in Section 8.3, will be closed to a foreign nation's groundfish trawl fisheries by the Regional Director if:

(a) that nation has no remaining PSC; and
(b) the amount of remaining PSC available to that nation can be harvested within one reporting period (one week).

Any closure of the Herring Savings Area will occur only between Sept. 30 and April 1. Once closed, it shall remain closed until April 1.

Rationale

The U.S. industry has demonstrated the capacity and its intention to harvest the total optimum yield of herring. Therefore, the TALFF is zero and no directed fishing for herring will be allowed.

Permitting retention of that incidental catch of herrng designated as PSC would free foreign trawlers to capitalize on catch opportunities that may develop at such times when U.S. observers or enforcement activities are not present. Such continuous monitoring will always be especially difficult during the winter period in the central and northern Bering Sea when herring are most available. If herring could be retained, the temptation to surreptitiously target on them, regularly offloading onto cargo vessels without reporting the catch, would be great.

Although herring is a prohibited species this alone provides no incentive to reduce the incidental catch. The Herring Savings Area closure ensures a greater degree of protection in order to address the management priorities of the FMP.

The purpose of the Herring Savings Area closure is to reduce the incidental catch of herring by foreign groundfish trawl fisheries when AIC has been reached. An in-season closure provision is necessary to allow the Regional Director to act within a reasonable amount of time to protect herring stocks from being overharvested during one reporting period.

iii. Joint venture buying/processing of OY apportionment permitted by non-trawl vessels even after PSC has been reached.

Rationale and clarification

Foreign vessels engaged in buying or processing groundfish from domestic vessels (i.e. joint ventures) shall be permitted to buy and/or process and retain herring harvested by U.S. vessels under OY provisions. If that nation's PSC has been reached and the joint venture operation is occuring in the Herring Savings Area, the buying/processing vessel may not engage in fishing or taking delivery of fish from non-U.S. vessels.

This measure will allow U.S. trawl vessels to market the AIC, summer and/or winter apportionments of OY in conjunction wth joint venture operations. This is the only case where any foreign vessel may have herring on board.

iv. The Herring Savings Area closure applies to trawl gear only.

Rationale

Trawl gear has historically had the greatest impact on herring stocks in the FCZ. Longline, pot and other gear which does not harvest herring to any significant degree are therefore exempted from the herring savings area closure.

12.4.2 Foreign reporting requirements

The operators of all foreign vessels must maintain an accurate log of catch and effort information in accordance with the requirements of the implementing regulations of the Bering Sea/Aleutina Islands Groundfish FMP and other foreign fishing regulations, 50 CFR Part 611.

12.4.3 Permit requirements

All foreign vessels fishing for groundfish in the FCZ must have on board a permit issued by the Secretary of Commerce, as required by the Magnuson Act.

12.5 In-season Adjustment of Time and Area

The Alaska Regional Director of NMFS, or his designee, may issue field orders adjusting time and area restrictions. The field orders may open or close fishing areas or parts thereof and fishing seasons based on the following considerations:

(a) the effect of overall fishing effort;
(b) the catch per unit effort and rate of harvest;
(c) the relative abundance of herring in comparison with pre-season expectation;
(d) the performance of the subsistence and commercial roe fisheries;
(e) the proportion of immature or spawned out herring and the age structure of the population;
(f) general information on the condition of herring;
(g) information pertaining to the optimum yield for herring;
(h) timeliness and accuracy of catch reporting by buyers to the extent that such timeliness or accuracy may reasonably be expected to affect proper management;
(i) the magnitude and distribution of incidental catch of herring in the groundfish trawl fisheries;
(j) any other information on herring distribution in the management unit; and
(k) any other factors necessary for the conservation and management of the herring resource.

Rationale

Success of any management program is greatly dependent on deliberately building flexibility into the governing system to allow timely changes in regulations to meet changing needs and conditions. This type of flexibility results in many benefits:

(a) New information and data relating to resource management can be immediately incorporated into the management program, even when the fishery is in progress.
(b) The management approach adopted before the season can be adjusted and refined during the season on the basis of assessments of actual resource conditions.
(c) Unanticipated resource conditions can be reacted to immediately to prevent both underfishing and wasteful under-utilization.
(d) The dangers posed by high effort levels and efficient harvesting units (as where fleet capacity equals or exceeds an OY) can be closely controlled.
(e) Management philosophies and policies formulated through legislative and administrative processes may be carried out in the field by biologists familiar with local conditions.
(f) Management approaches which are proving unworkable or which are imposing undue hardships on users may be changed at once.
(g) Necessary in-season refinements in management programs can be accomplished primarily in the field with the advice and assistance of the users most directly affected.

In order to assume effective management of the herring resource as a unit throughout its range, in-season adjustments made by the Regional Director should be coordinated with similar actions taken by the State in waters under State jurisdiction, when such actions are consistent with this FMP and the Magnuson Act. It is necessary that the Regional Director, to the extent possible, act in conjunction with ADF&G in order to effect uniformity of management in State waters and the FCZ. As a result, any changes proposed by the Regional Director will be accompanied by advance notice to the State to allow for opportunity to maintain such uniformity.

In all cases, continuous consultation between ADF&G and the Regional Director will be maintained.

It is expected that the actual opening and/or closing dates for the seasons prescribed in this plan will be adjusted by the Regional Director pursuant to the authority described in this section. Such action is not considered an action that would require amendment of this FMP, or of regulations implementing this FMP.

12.6 Resources Required for Implementation and Enforcement

12.6.1 Domestic enforcement

The United States Coast Guard and NMFS would have primary responsibility to ensure that domestic vessels fishing for herring and groundfish in the FCZ comply with this FMP and its implementing regulations. Enforcement agencies of states in which United States vessels land herring caught in the FCZ would support the Federal enforcement effort through landing laws.

12.6.2 Foreign enforcement

The Coast Guard and NMFS will also have primary responsibility for ensuring that foreign vessels fishing for herring and groundfish in the FCZ comply with this FMP and its implementing regulations. Fisheries enforcement patrols will probably be focused on all facets of foreign fishing throughout the eastern Bering Sea, rather than specifically monitoring foreign harvests of herring. As a result, each patrol will probably devote its efforts to enforcing compliance with all fishery plans in effect and to other statutory responsibilities applicable to the area covered by the patrol.

12.7 Research

Research will be required to (1) find means of improving the accuracy of foreign catch statistics, (2) develop means of reducing the incidental catch of herring in other fisheries, (3) refine estimates of abundance and biological characteristics of stocks through resource surveys, (4) improve the

capability for predicting changes in resource abundance, composition, and availability, and (5) identify the origin and distribution of stocks in offshore waters.

Discrepancies have been found between reported catches by skippers of foreign vessels and those estimated by U.S. observers aboard those vessels. Observer estimates have been generally greater than those reported by the vessel masters, suggesting under-reporting of catches by the foreign fleets. This problem needs to be examined and steps taken to improve the accuracy of reported catch statistics if the catch quotas or other management measures pertaining to the foreign fishery are to have any significance. The distribution and frequency of herring in the foreign catch also need to be examined so that herring conservation measures which do not seriously interfere with other fisheries can be formulated.

For purposes of conservation and harvesting efficiency, fishing methods or gear should be modified or developed which will reduce the incidental catch of herring in groundfish trawl fisheries.

Estimates of biomass of specific groundfish resources have been obtained through resource surveys using bottom trawls. However, herring are not generally available to bottom trawls and other gear and methods must be used for assessing biomass. Hydroacoustic surveys, spawn deposition surveys and aerial surveys of schooled fish are some of the methods under consideration.

Hydroacoustic surveys in the nearshore areas just prior to or during spawning are probably not practical due to the many widely scattered schools that are constantly moving through shallow waters. Hydroacoustic surveys are probably best conducted when herring are relatively concentrated on the winter grounds. Results of surveys conducted during late winter - early spring could be applied in time for management of the inshore fisheries. Some increased ability to identify discrete spawning stocks in the offshore survey area would also be desirable.

Spawn surveys, similar to those employed in British Columbia, convert the amount of spawn deposited to the size of the adult population using age-sex-

size composition and fecundity data. Surveys would have to be conducted immediately after spawning to minimize losses from predation and storms. The vast size of the area including distances between spawning areas, lack of sub-tidal spawning information and various logistical problems currently render this method impractical for the eastern Bering Sea.

Aerial surveys may be one of the more cost effective tools for measuring the abundance of spawning herring. However, this method may be limited due to weather conditions and narrow time-area coverage. Intensive testing should be made of school distribution within a limited area to determine if surveys are more effective at particular times and to investigate the variability of schools along sighting tracks. Also, aerial biomass estimation procedures and species identification procedures need to be developed.

If a model of spawning school distribution could be developed, then statistical procedures could be used to overcome some of the weather and time limitations. Satellite technology may be a means of augmenting aerial surveys in that large schools may be observable at distances from the coast or spawn deposition (milt) may be observable from satellites. A combination of low level aircraft and satellite observations may provide answers to the effective coverage of tracklines and time-space distribution of schools.

Long-term fisheries management requires reliable forecasting of stock conditions. Until now, forecasts have been based mainly on past events, such as trends in abundance indices (catch per unit effort) and size and age composition of specific resources without any consideration of the interactions of these resources with each other and the environment. Studies need to be continued to determine for predictive purposes those factors that have major influences on the abundance, composition, and distribution of resources. Monitoring certain oceanographic and climatological conditions (temperature, currents, etc.) in both the nearshore spawning-rearing grounds and the offshore wintering grounds may be very important in understanding fluctuations in herring abundance.

There is a critical need for annual pre-recruit surveys (i.e. of young fish before they enter the fisheries) so that a measure of their abundance can be

used to forecast later contribution to the exploitable stock. Assessment of pre-recruit abundance could be made of juveniles in nearshore nursery areas or at a later age in more offshore waters. The major limitation for use of this method is the virtual absence of information relating to distribution of eastern Bering Sea herring during the first two or three years of their life cycle.

Current studies in inshore waters are emphasizing the assessment of stock condition through aerial survey observation of schooled fish and age composition data collected from commercial and test fishing catches. Age composition data when collected over a number of years are indicative of the relative strength of various year classes including newly recruited fish, and may be used to a limited degree in adjusting quotas and formulating other management measures.

The preceding methods for assessing current and future herring stock condition including biomass estimates, all have limitations to one degree or another. It may be necessary to use different methods depending on the area or a combination of several methods to achieve the desired results for achieving an improved management system.

Basic biological research is needed to systematically investigate population parameters, such as age-specific mortality rates, growth rates, and recruitment rates. Investigations are also needed to establish the degree of utilization of herring in the diet of marine mammals, salmon, and other predators so ecological effects of harvesting can be better evaluated.

Lastly, stock identification needs to be refined so that the distribution of stocks within the eastern Bering Sea and their frequency of occurrence in each fishery can be established.

12.8 Costs

Costs of managing the herring resources in the Eastern Bering Sea are currently borne almost exclusively by the State of Alaska. Current federal fishery management costs result from groundfish operations and include

enforcement and aerial surveillance, on-board observer program, and limited high-seas research. Observer costs are reimbursable by foreign nations, and no additional costs are expected to occur from implementation of this FMP. Likewise, additional enforcement efforts are not expected to result.

Research expenses offshore would be borne primarily by the federal government, while inshore research and management would probably continue to be conducted at state expense. Any federal research expenses would result regardless of whether the herring resource is managed through a herring FMP, groundfish FMP, or PMP, and would be one-time only rather than continuing expenses.

13.0 RELATIONSHIP OF MANAGEMENT MEASURES TO NATIONAL STANDARDS AND OTHER APPLICABLE LAWS

The management regime prescribed in Section 12.0 of this FMP conforms with the National Standards set forth in Section 301 of the Magnuson Act. It also conforms with all international conventions which directly or indirectly address conservation and management of herring and other fishery resources in the Bering Sea/Aleutian region (Section 4.2). There are no Indian treaty fishing rights related to Bering Sea herring.

The proposed management regime for the high seas domestic fishery is currently in conflict with the State of Alaska regulations which prohibit trawling for herring north of 56° N. latitude. Cooperation between the Board and the Council is required to resolve this difference, but upon implementation of this FMP by the Assistant Administrator, its provisions will prevail over conflicting State regulations.

The relationship of recommended management measures to the Coastal Zone Management Act, the Marine Mammal Protection Act, and the Endangered Species Act is discussed in more detail in the Environmental Impact Statement, Section 16.3.

14.0 COUNCIL REVIEW AND MONITORING OF THE PLAN

The North Pacific Fishery Management Council will, after approval and implementation of this plan by the Secretary, maintain a continuing review of the fisheries managed under this plan. Specifically, the Council shall:

(1) Maintain close liason with the management agencies involved, usually the Alaska Department of Fish and Game and the National Marine Fisheries Service, to monitor development of the activity in the fisheries;

(2) Promote research to increase knowledge of the fishery and the resource, either by direct funding or by recommending research projects to other agencies;

(3) Conduct public hearings at appropriate times and in appropriate locations, usually at the close of a fishing season and in those areas where a fishery is concentrated, to receive testimony on the effectiveness of the management plans and on requests for changes;

(4) Consider all new information and develop, if necessary, amendments to the management plan. The Council will also hold public hearings on proposed amendments prior to forwarding them to the Secretary for possible adoption; and

(5) The procedure for establishing the winter apportionment of OY shall be reviewed within three years.

DRAFT

FINAL

ENVIRONMENTAL IMPACT STATEMENT ON THE BERING-CHUKCHI SEA HERRING FISHERY MANAGEMENT PLAN

U.S. DEPARTMENT OF COMMERCE
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JULY 1983

COVER SHEET

RESPONSIBLE AGENCIES:

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National Oceanic and Atmospheric Administration
United States Department of Commerce
Washington, D.C. 20235

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PROPOSED ACTION: Approval and implementation of the Bering/Chukchi Sea Herring Fishery Management Plan.

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TYPE OF STATEMENT:

( ) Draft (X) Final

ABSTRACT:

This Statement evaluates the direct and indirect impacts upon the quality of the human environment of the implementation of a fishery management plan prepared pursuant to the Magnuson Fishery Conservation and Management Act. This Statement also evaluates the impacts on the human environment of alternatives to these actions. It concludes that the management measures under the plan as proposed will have a beneficial impact on the herring resource, on marine mammals, birds and fish which prey upon herring, and upon subsistence and commercial fishermen who utilize the herring resource.

TABLE OF CONTENTS

I. SUMMARY

This Statement examines the direct and indirect impacts upon the human environment of the approval and implementation of the Fishery Management Plan for Bering/Chukchi Sea Herring (FMP). The FMP was adopted by the North Pacific Fishery Management Council (Council) and submitted to the Assistant Administrator for Fisheries (Assistant Administrator), National Oceanic and Atmospheric Administration (NOAA), for approval and implementation under the Magnuson Fishery Conservation and Management Act (Magnuson Act).

This Statement has been prepared pursuant to Section 102(2)(C) of the National Environmental Policy Act (NEPA) and its implementing regulations. It concludes that offshore commercial herring fishing operations in the Bering/ Chukchi Sea management area have the following types of impacts on the quality of the human environment:

1. reduction in the size of the herring biomass;
2. incidental harvest of other marine resources;
3. direct stress to marine mammals and birds;
4. environmental polution resulting from dumping at-sea by catcher and/or processing vessels; and
5. damage to benthic organisms caused by gear interaction with the sea floor.

Precise data on these impacts are not currently available, but the information that does exist indicates that they do not significantly affect the environment of the Bering Sea area. In reviewing the management alternatives considered by the Council, this Statement concludes that the measures proposed by the FMP will restrict the geographical extent, permissable harvest, and duration of herring fishing operations (and to a variable degree the groundfish fishing operations) and will tend to mitigate the impacts on the environment. This Statement concludes that approval of the FMP will ensure that fishing operations in the FCZ will not lead to overfishing and that the herring resource will be maintained at an optimum level. Approval of the FMP will thus result in a beneficial impact upon the herring resource itself; marine mammals, birds and fish which are predators upon herring; and upon subsistence and commercial fishermen who utilize the herring resource.

In comparing alternative management measures, this Statement concludes that the alternatives as proposed in the FMP provide the best balance between rebuilding and maintaining herring stocks and promoting the development of herring fisheries in western Alaska and of domestic groundfish fisheries in the Bering Sea. While the FMP imposes additional restrictions on foreign groundfish trawl fisheries, these restrictions should not interfere with attainment of optimum yield and full utilization of groundfish resources. This Statement also concludes that the imposition of herring management measures even more conservative than those adopted in the FMP would be unlikely to provide additional protection to herring resources of a magnitude justifying the significant additional burdens such measures would impose on offshore groundfish and herring fisheries.

The alternative of not adopting, approving, or implementing the FMP and continuing the current management of herring in the Fishery Conservation Zone (FCZ) under a Preliminary Fishery Management Plan (PMP) and in Alaska territorial waters under separate state strategies would leave unregulated domestic herring fisheries in the FCZ except those involving the delivery of domestically harvested fish to foreign processing vessels. This would be in noncompliance with National Standard 1, Section 301 of the Magnuson Act, requiring that conservation and management measures prevent overfishing; and with National Standard 3, requiring that a stock of fish be managed as a unit throughout its range to the extent practicable.

This Statement was preceded by a draft environmental impact statement (DEIS) in October 1979. This Statement includes revisions that reflect public comments made both during and subsequent to the public review period on that draft statement. Revisions to the FMP itself have been made in response to issues raised and comments made during the review process. These changes will provide additional protection to the herring resource by further restricting the domestic FCZ fishery for herring, eliminating the foreign herring fishery, and ensuring that the management measures are both clear and unambiguous in their intent and effect. The Council's preferred alternatives as reflected in the FMP are identified in this Statement.

This Statement incorporates by reference the following documents:

1. The FMP.
2. The Regulatory Impact Review/Initial Regulatory Flexibility Analysis (RIR/IRFA) for the FMP
3. The Environmental Impact Statement for the Groundfish of the Bering Sea/Aleutian Islands Area, dated August 1981.
4. Council Document #3. The Social and Economic Impacts of a Commerical Herring Fishery on the Coastal Villages of the Arctic/Yukon/Kuskokwim Area.

These documents are available upon request from the North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, Alaska 99510.

II. PURPOSE OF AND NEED FOR PROPOSED ACTION

The Magnuson Fishery Conservation and Management Act (Magnuson Act) established a Fishery Conservation Zone (FCZ) which extended U.S. jurisdiction to 200 miles beyond the coastline of the United States. The Magnuson Act also established eight Regional Fishery Management Councils to aid in the management of the fishery resources within this 200 mile zone. Each Regional Council is charged with preparing a Fishery Management Plan (FMP) for each fishery within its jurisdiction which is in need of management. The purpose of an FMP is to prevent overfishing, to provide for an optimum yield of the resource to the fishemen and to the nation, and to promote fair and equitable sharing of the resource in accordance with the National Standards set forth in Section 301(a) of the Magnuson Act. The North Pacific Fishery Management Council (NPFMC or Council), with assistance from the Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service (NMFS), has developed this FMP for the herring resource of the Bering and Chukchi Seas.

When a Council has adopted an FMP for a fishery under its jurisdiction, the FMP must be submitted to the Secretary of Commerce for approval and implementation by him. The Secretary has delegated this authority to the Assistant Administrator for Fisheries (Assistant Administrator) of the National Oceanic and Atmospheric Administration (NOAA). The Assistant Administrator is the

head of NMFS. Upon receipt of an FMP from a Council, the Assistant Administrator must determine whether it is consistent with the Magnuson Act and other applicable law. If he so finds, he tentatively approves the FMP, and publishes it for public comment together with proposed implementing regulations. If, in light of this public comment, the Assistant Administrator reaffirms his finding of the consistency of the FMP with the Magnuson Act and other applicable law, he publishes final regulations implementing the FMP. An FMP may be amended in accordance with these procedures.

Foreign fishing in the FCZ may be authorized under permits to the extent that the marine resources in question will not be harvested by United States fishermen. If an FMP has not been implemented for a fishery in which foreigners wish to participate, the Assistant Administrator must prepare and implement a Preliminary Fishery Management Plan (PMP) for that fishery. A PMP and its implementing regulations govern only foreign fishing operations, and do not limit the activities of United States fishermen. A PMP and its implementing regulations are automatically suspended when an FMP is implemented for the fishery to which the PMP applies. A PMP is currently in effect for herring in the Bering Sea management unit but no foreign fishing is allowed.

The Bering/Chukchi Sea Herring FMP has evolved over a period of several years. During this period numerous changes have occurred in the domestic and foreign fisheries, the herring resource itself, and the scientific information available for management. When drafting of the FMP was initiated the inshore commercial fishery was in an undeveloepd stage, and little or no directed offshore herring fishing was occuring. The inshore fishery expanded rapidly as fishermen became familiar with the area and market strength and availability continued. Growth of the offshore fishery was restricted by State regulations prohibiting offshore harvest and by a U.S. district court order which struck down the PMP provisions which would have allowed joint venture operations. By 1980 the domestic inshore commercial harvest capacity equaled or exceeded the total harvest which would be allowed by the proposed FMP provisions. However, domestic herring fishing operations offshore, although currently inactive, remain largely uncontrolled, and a potential exists for overfishing if the inshore and offshore harvests are not coordinated. The

Council has adopted this FMP in order to ensure coordination and cooperation among the management agencies and to provide a mechanism for determining the optimum yield of the herring resource and its harvest by competing user groups.

The FMP takes account of the management strategy of the State of Alaska for the inshore herring commercial and subsistence fisheries, and proposes management measures designed to protect herring against incidental offshore harvest in the trawl fisheries and to develop offshore domestic directed herring fisheries. The FMP provides the means to identify major data gaps needed to resolve conclusively issues such as the impact of offshore fisheries on the survival of the smaller inshore spawning stocks and to obtain research funding for data collection and analysis. Most importantly, it establishes a cooperative management system with considerable in-season flexibility, and insures increased coordination and cooperation among the Council, ADF&G, the Alaska Board of Fisheries (Board), and NMFS, NOAA.

III. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

The FMP describes the status of herring stocks and fisheries and proposes management measures for the offshore fisheries. Alternatives to these measures have been reviewed and rejected. In order to avoid duplication in the discussion of environmental impacts, these measures are grouped under three major headings: the concept of Optimum Yield, the incidental catch of herring in the FCZ and directed harvest of herring in the FCZ. A description of the adopted management measures and their alternatives, and a comparison of their anticipated environmental impacts are presented in this chapter.

A. Proposals and alternatives concerning the concept and calculation of Optimum Yield.

During the development of the FMP the Council discussed several approaches to both the calculation and application of the Optimum Yield (OY). The preferred alternative applies OY to the offshore fishery only, and OY is calculated by subtracting the total inshore catch from the Acceptable Biological Catch. No management procedures or limits are suggested for those inshore fisheries.

The FMP recognizes that conservation measures taken in the FCZ can do little to eliminate the possibility of overfishing without similar action by the State of Alaska in the Territorial Sea. Thus, the FMP establishes the means to coordinate management between the two jurisdictions. The actual differences in biological impacts between a resource-wide OY and an FCZ OY are minimal and are not further discussed in this Statement.

1. Adoption of procedures and criteria proposed in the FMP.

The FMP specifies the Maximum Sustainable Yield (MSY) over a continuing period of time. MSY is established at 48,712 mt which is the average foreign fishery catch from 1962 to 1976. A discussion of the rationale for selecting this method is discussed in detail in Section 7.6.1 of the FMP. Assuming an average 0.20 exploitation rate during this period, the biomass at MSY level is 243,560 mt. This estimate is based on the best scientific information available although the quality of the data is less than desired. As additional information on stock status and distribution becomes available from monitoring the fisheries and from directed herring research, the MSY estimate may be revised.

Herring populations fluctuate from year to year as a result of short-term changes in growth, recruitment and mortality factors. It is thus not appropriate to set the annual harvest level at MSY, but rather adjust the allowable harvest annually to reflect these changing conditions. In this way MSY can be achieved over the long term.

The annual estimate of this Acceptable Biological Catch (ABC), discussed in Section 7.6.2 of the FMP, will be calculated by applying an appropriate exploitation rate to the best available estimate of current biomass. This rate will be 0.20 multiplied by the ratio of current biomass to MSY biomass; however, in no case will the rate be greater than 0.20. The reasons for selection of this exploitation rate are described in Section 7.6.2.2 of the FMP. Spawning biomass surveys are based on aerial survey counts of herring schools with the greatest amount of available information from the Bristol Bay/Good News stock grouping, the Kuskokwim/ Yukon River Delta and the Norton Sound stock grouping. These tentative

stock groupings are based on similarities of distribution, behavior, utilization and abundance. Estimates are not available for the Aleutian/ Alaska Peninsula stock grouping or the Port Clarence/Kotzebue Sound stock grouping, and neither is currently included in the biomass estimate used in the ABC formula.

An Allowable Incidental Catch (AIC) of herring by the domestic groundfish trawl fisheries and a Prohibited Species Catch (PSC) for the foreign groundfish fisheries are calculated by multiplying each nation's Bering Sea/Aleutian Islands groundfish allocation by 0.1%. This factor (0.1%) was determined based on the average incidence rate of herring in Japanese trawl operations during 1979, 1980 and 1981. AIC is part of the herring OY, while PSC is not (although it is subtracted in the formula for determining the winter apportionment of OY).

The Optimum Yield (OY) is that portion of the ABC which is made available for harvest in the FCZ. OY is the sum of three components: AIC, a summer apportionment, and a winter apportionment. AIC is available for harvest when no directed herring allocation is available, except as limited by the FMP. The summer apportionment of OY is provided for the summer fishery in the Aleutian Islands (south of 55°47'N latitude) and may be harvested from July 1 through September 30. When 2,000 mt has been harvested in the FCZ and the territorial sea taken together, the FCZ south of 55°47'N latitude shall be closed to fishing for herring until the next apportionment is made. The Regional Director has the authority to reduce this apportionment in exceptional circumstances.

A winter apportionment of OY will be made available if the resource has not been utilized by the preceding fisheries. The winter fishery (if any) will take place throughout the management unit from October 1 until March 31, the end of the fishing year. The winter apportionment of OY for the management unit, to be calculated annually, shall be one-half of the remainder of ABC after subtracting certain quantities, as described in Section 10.3, as follows:

$$\text{Winter Apportionment of OY} = \frac{\text{ABC - inshore commercial harvest - subsistence adjustment - AIC}}{2}$$

This apportionment is limited as follows:

(a) If the amount so calculated is less than 2,000 mt,. or if the current herring biomass is less than 122,000 mt (one-half of the MSY biomass), this apportionment shall equal zero.

(b) Under no circumstances shall the apportionment for the winter offshore fishery be greater than 10,000 mt.

(c) In exceptional circumstances, the amount calculated above may be further reduced if NMFS, in consultation with the Council and ADF&G, finds a serious problem resulting from any of the following factors:

(1) condition of the several spawning stocks of herring, with special focus on the availability for subsistence harvest;

(2) the abundance of spawning herring and their spawning success;

(3) age composition of the herring population;

(4) recruitment to the spawning stocks of herring;

(5) distribution of preceding inshore and offshore harvests among the several geographical groups of spawning herring.

(d) This procedure for determining the winter offshore apportionment will be reviewed at the end of three years.

2. <u>OY derived from a long-term estimate of yield; annual harvest represented by a Total Allowable Catch (TAC)</u>.

The concept of the Total Allowable Catch (TAC) was included in the initial draft of the FMP (March 1979). It was developed as an annual component of Optimum Yield primarily to avoid the administrative problems inherent in specifying an annual OY. The relationship of TAC and OY would have paralleled that of ABC and MSY. OY was proposed as a long-term estimate of yield modified from MSY/ABC for socioeconomic reasons. TAC was the annual socioeconomic estimate of yield determined from ABC. This concept would have required the determination of long-term socioeconomic goals. Long-term goals were considered during the development of the FMP, but the subject was deferred until the developing fisheries stabilize. The TAC

nomenclature was changed to OY to conform to the generally accepted OY concept after the definition of OY was broadened.

3. Preliminary/Final OY procedure.

The TAC procedure in the initial draft of the FMP was modified into a two-step procedure for determining and allocating OY. In this procedure OY applied to the total directed Bering Sea herring harvest. The preliminary OY was to be established in September of the previous year and would have acted as a guideline harvest for the spring roe fishery inshore. In September a final OY would be determined based on analysis of stock assessment and inshore harvest success. This final OY would also act as the next year's preliminary OY. This procedure was originally intended as a signal to the fishing and processing industry so that they could prepare for the upcoming roe fishery. As this fishery is now well-developed, the preliminary OY is no longer necessary. However, under the proposed procedure OY is not finally determined until September, when all biomass and harvest data are available.

4. Procedures and criteria proposed in the FMP with higher or lower base exploitation rates.

Exploitation rates were discussed at great length before the Council adopted the formula in the FMP. Japanese fishermen's groups felt that higher exploitation rates could be sustained by the herring populations, while native Alaskan groups felt that additional harvest restrictions are needed to protect herring available to subsistence and other domestic fishermen. The Council decided that a higher exploitation rate would be inconsistent with the conservative approach that lack of data seems to call for. On the other hand, a lower rate would not provide additional protection to the herring populations commensurate with the costs to the herring and groundfish fisheries, especially since the 0.20 base rate is subject to adjustment based on biomass levels, since the small exploitation rate will be no greater than 0.20, since only one-half of the "surplus" is to be apportioned to the winter offshore fishery and since any such fishery will not in any case be apportioned more than 10,000 mt.

Environmental Impact

The OY concept and calculation method proposed in the FMP are designed to maintain herring stocks at or near levels that will support MSY. The increase in and stabilization of herring abundance that should result will benefit the natural and physical environment and both users of the herring resource itself and users, both consumptive and non-consumptive, of mammals, birds and fish that prey upon herring. Spawning biomass estimates have indicated that the major populations have rebounded from earlier depressed levels are are now somewhat stable although below MSY levels. The conservative management regime proposed in the FMP, combined with the traditionally conservative management strategy practiced by the State of Alaska, will allow stocks to return to MSY levels when biological/environmental conditions are adequate.

Even more restrictive measures could cause increased herring abundance. This would probably increase benefits to the natural and physical environment and to inshore subsistence users of herring and predator species. It would, however, impose burdens upon commercial users of herring and groundfish operating in offshore fisheries. Less conservative approaches to OY would reduce benefits to the natural environment and subsistence users, while reducing burdens on commercial users of herring engaged in offshore herring and groundfish trawl fisheries.

Offshore herring fisheries may result in an increase of the amounts of waste products dumped at sea. Such wastes will be minimal, however, since in order to be economically viable, offshore herring fisheries must maintain a very high product recovery rate. Additionally, the wastes that are produced will be readily assimulated into the vastness of the Bering Sea at a rate which, if it is measurable at all, would have a positive effect on the productivity of the area.

B. Proposals and alternatives concerning incidental harvest of herring in the FCZ.

The incidental catch of herring in the offshore trawl fisheries is discussed in Section 8.3 of the FMP. Offshore groundfish fisheries targeting on pollock

and other pelagic species inevitably catch a small percentage of herring. Because of the high priority that the Magnuson Act expressly assigns to groundfish fisheries off Alaska, this incidental catch is considered unavoidable. At the present time, the offshore trawl fishery is predominantly foreign, but domestic fisheries and joint ventures are rapidly expanding and considerable fisheries development effort is being directed towards domestic groundfish processing. Management measures applied to reduce incidental catch of herring would ultimately have to apply to both foreign and domestic trawl fisheries. Two approaches to this matter were considered by the Council: (1) limiting the allowable incidental catch level of herring throughout the Bering Sea year-round; and (2) the establishment of a herring savings area to protect herring while concentrated in offshore wintering areas.

The question of allowing retention of this incidental catch by trawlers was also addressed, but the biological impact would be the same since all herring returned to the sea after capture would die.

1. Limiting allowable incidental catch levels of herring throughout the Bering Sea year-round.

   (a) Allowable incidental catch level as proposed in the FMP.

   The allowable incidental catch level as proposed by the FMP is determined by multiplying each nation's Bering Sea/Aleutian Island groundfish allocation by 0.1%. This incidental catch is called the Allowable Incidental Catch (AIC) for the domestic groundfish fishery and the Prohibited Species Catch (PSC) for foreign groundfish fisheries. AIC is part of OY and may be retained; PSC must be reported but may not be retained. PSC is not part of OY.

   Once a nation exceeds its AIC/PSC, that nation would be prohibited from further trawling for the remainder of the fishing year in all or part of the Herring Savings Area, as described in Section 8.3. In addition, herring will become a prohibited species for that nation throughout the Bering Sea. The rationale for this management measure is that fishing vessels would make efforts to minimize the incidental

catch of herring in order not to jeopardize the harvest of their groundfish allocations. A true incidental catch of herring is a necessary feature of any groundfish trawl fishery in the Bering Sea, but the level of incidental catch can be controlled through careful fishing practices.

(b) Establishment of herring as a prohibited species.

This alternative would require that all incidentally caught herring be returned to the sea. Essentially all herring captured in trawls die in the net or on deck so no benefit would result to the herring resource by their return. Unless a penalty fee was applied, no incentive would exist to avoid herring concentrations and a penalty fee, without a high degree of observer coverage, could encourage under-reporting. The FMP measures combine the prohibited species approach with a penalty for foreign nations and should achieve the best results.

(c) AIC calculated under a different method.

Several alternative methods of calculating AIC/PSC were considered by the Council and rejected. Among these was a formula which was intended to adjust the allowable incidence rate based on changes in herring biomass estimates as well as the groundfish allocations. Analysis of the proposed formula indicated that in certain circumstances AIC/PSC would increased even though the herring stocks decreased. Rather than revise the formula, which would have added to its complexity, the Council adopted the proposed simplified procedure.

Environmental Impact

The conservative management approach expounded in the FMP requires that the needs of the herring population are given the greatest priority, but also that maximum utilization of herring as a food resource be addressed whenever possible. A main purpose of the AIC is to allow a groundfish fishery in spite of the incidental catch of herring, but at the same time to limit this incidental catch as much as possible.

Section 8.3 of the FMP provides a detailed review of the incidence of herring in the foreign groundfish fisheries. From this discussion it is apparent that different practices lead to different incidental catch rates. The FMP sets the allowable rate of 0.1%, which is the 1979-81 average rate by large Japanese trawlers in the Bering Sea. This rate is lower than the rates calculated for other foreign fisheries but was chosen because (1) it will reduce the overall incidental catch, and (2) the large trawlers have demonstrated that this incidence rate can be achieved.

Although the procedures for establishing AIC are based on incidence rates reported during 1979, 1980 and 1981, and do not, therefore adjust for annual fluctuation in herring abundance, spawning biomass estimate as reported by ADF&G for those years were 252,700 mt, 74,800 mt and 182,600 mt, respectively, which represents an adequate range for the immediate future.

If this approach is found to be too restrictive on domestic groundfish fishermen, or if it provides inadequate protection to herring stocks during their offshore sojourn, the Plan Maintenance Team of the Council will propose alternative approaches and the FMP will be amended.

The success of any program to reduce the directed or incidental harvest of herring offshore depends on adequate reporting by fishermen and monitoring of those fishing activities. The FMP provides the means to analyse the effectiveness of these measures.

2. Establishment of a Herring Savings Area.

The issue of a Herring Savings Area is discussed in detail in Section 8.3 of the FMP. The concept of the Herring Savings Area was approved by the Council as a means of protecting herring offshore, especially during the period November to March when herring are concentrated offshore. The area would be closed to any nation which reaches its AIC or PSC prior to January 1.

(a) Selection of Area C as proposed in the FMP.

This is the largest of the areas considered and, therefore, affords the most protection for herring. At the same time it also creates the greatest potential impact on the trawl fisheries. As a result, the Regional Director has been given the authority to close any portion or all of the area, depending upon the particular location of herring concentrations in that year. In this manner, maximum protection can be given to herring with minimum disruption of the trawl fisheries. This closure authority would come into effect for foreign trawlers when their PSC was exhausted and for domestic trawlers when both their AIC and any winter apportionment of OY were exhausted. A smaller area will be closed prior to November 1 to any nation reaching its AIC/PSC prior to that date. The extent of any closure may be modified by Council/Regional Director action. This is the preferred alternative.

(b) Selection of a smaller area.

Areas A, B and D, described in the FMP, are smaller than Area C. The difference in protection afforded herring appears insignificant although the degree to which the trawl fisheries are affected may be considerably greater. However, little flexibility is provided in the event herring wintering areas shift slightly due to environmental conditions.

(c) No Herring Savings Area.

Although there would be no restrictions on the trawl fisheries, no protection would be provided for herring during the winter months.

(d) Annual closure of Savings Area.

The Council considered the alternative of closing the Herring Savings Area every year, as suggested by some native Alaskan organizations,

regardless of remaining AIC or PSC. Mandatory yearly closures are unnecessary in view of strict PSC/AIC limitations, which will be monitored through observer coverage.

Environmental Impact

The Herring Savings Area closure is intended to protect mixed herring stocks from excessive harvest by trawl fisheries. The yearly closure (alternative d) would have the most beneficial impact on herring stocks but was not considered necessary, particularly in light of the costs to the groundfish fishery. Selection of a smaller Savings Area, or no Savings Area (alternatives b and c) provide the least protection to the physical and biological environment but reduce the impact on the groundfish trawl fisheries. The action proposed in the FMP would set a limit on the amount of herring to be taken and would allow each nation's trawl fishery to continue until that nation's PSC or AIC is acheived. This preferred action provides the necessary protection to the herring resource while allowing the maximum utilization of the groundfish resource.

A possible side benefit to the herring savings area is that, upon closure, a reduction in the incidental catch of chinook salmon could be anticipated. Concern has been recently expressed about increases in the offshore interception of western Alaska salmon by foreign trawlers. Since a strong predator-prey relationship exists between chinook salmon and herring, salmon aggregation in the vicinity of wintering herring schools can be expected.

C. Proposals and alternatives concerning directed domestic harvest of herring in the FCZ.

The commercial herring fisheries are described in detail in Section 3 of the FMP. Briefly, the sac-roe fishery occurs in state waters, not in the FCZ, and the domestic food and bait fishery has in recent years been entirely in state waters. Interest in this fishery is expected to increase and could potentially expand into the FCZ. Additionally, joint venture groundfish fisheries consider food herring as a potentially important source of supplemental income;

however, since February 1980 the delivery of herring at sea to foreign processing vessels has been prohibited.

The most important issue addressed by the Council in considering management measures for the FCZ fisheries regarded the possible effects of offshore fisheries on mixed stocks of herring. Native organizations, inshore commercial fishermen and ADF&G have expressed concern that herring fishing operations offshore would operate on mixed stocks of herring and could potentially overharvest smaller or weaker stocks which are comingled with larger or healthier stocks. Overharvest of small discrete stocks could occur in the event that those stocks are not evenly distributed and are harvested in amounts significantly greater than their proportion of the total stock. Evidence of the deleterious effects of mixed stocks fishing came primarily from public testimony about the crash of locally important spawning stocks which resulted from foreign trawl fisheries during the 1960s and 1970s. Opponents to mixed-stock herring fisheries argue that inshore management can better control the harvest of each individual stock and prevent the decline of small but important stocks. This view is held most strongly by native Alaskans who depend on herring for subsistence purposes. It is particularly important to them because subsistence harvesting gear and techniques are less efficient than those of commercial fishermen and thus greater fish densities and availability are required.

On the other hand, the FMP contains data indicating that these smaller stocks have multiplied many times over during periods when offshore harvest levels were much greater than those that would be allowed under the FMP. The Council has exercised caution in the management of the offshore fishery and has incorporated measures into the FMP to reduce the potential impact. However, the Council has not rejected entirely mixed-stock fisheries. The Council clearly felt that, in light of the priority of the inshore fisheries and the measures to protect against the incidental harvest of mixed-stocks of herring, the directed offshore harvest of herring should also be limited, but not be rejected, at this time.

Section 12.7 of the FMP addresses research needs including the need to identify the origin and distribution of stocks in offshore waters. Such research would elucidate the potential problems of directed mixed-stock herring fisheries.

1. Apportionment to the summer domestic food and bait fishery.

Although spawning biomass assessments from the spring fishery would not yet be completed, the Council felt it should provide an annual apportionment to the summer food and bait fishery on July 1. This apportionment would differ from the October 1 apportionment to the winter food and bait fishery in that it would, except in extreme circumstances, occur regardless of the magnitude of the sac-roe harvest relative to spawning biomass. The Council considered three alternatives with respect to this fishery.

(a) Restrict the harvest to south of 55°47'N latitude (preferred alternative).

This alternative would limit the harvest of herring to the Aleutian Islands/Alaska Peninsula area. Although some herring spawning does occur in this area, the proportion of locally spawning stocks present in this summer fishery is not known at the present time. Some of this harvest is supported by stocks that spawn elsewhere and have migrated to the area, however. Since the current fishery now occurs in the Aleutian Islands/Alaska Peninsula area, the Council elected to restrict it to an area south of 55°47'N latitude. This particular latitude was selected because State of Alaska regulations now prohibit domestic herring fishing north of that latitude. The Regional Director of NMFS will determine the summer apportionment of OY prior to July 1, and the Council will review and provide for public comment on his decision.

(b) Permit the harvest anywhere in the FCZ.

This alternative would permit the summer food and bait fisheries to target on herring stocks migrating from coastal areas where they had

already been subjected to harvest during the spring sac-roe fisheries. Since the annual apportionment to the summer fishery will occur regardless of the magnitude of the sac-roe harvest relative to spawning biomass, the Council thought that northward expansion of the existing Aleutian Islands/Alaska Peninsula fishery was unwarranted.

(c) Prohibit a summer food and bait fishery in the FCZ.

This alternative would, in effect, limit the existing fishery to state waters. One of the objectives of the FMP, however, is provide a unified management regime between Federal and State jurisdictions. The summer herring fishery is economically viable and provides for the development of alternative markets to the potentially unstable Japanese sac-roe market. At the present time, there are no valid reasons for prohibiting this fishery from occurring in the FCZ although to date the entire harvest has occurred in state waters. The FMP does contain provisions for closing the FCZ by emergency order should the State of Alaska find reason for closing the fishery inshore.

Environmental Impact

While the origin of those herring stocks that support the Aleutian Islands/Alaska Peninsula summer fishery are unknown at this time, the possibility exists that these stocks may not be stocks that spawn in the Aleutian Islands/Alaska Peninsula area but rather stocks that have spawned in the Togiak area or areas further to the north and which have already been subjected to harvest during the spring sac-roe fishery. Stock identification studies to determine the origin of these stocks have already begun and the results will be used to determine if modifications to the proposed procedure are necessary. If these stocks are indeed subject to harvest during the sac-roe fishery, the State of Alaska may elect to reduce the sac-roe harvest and permit the food harvest to continue, or to reduce the Aleutian area harvest. Alternative (a), limiting the fishery to waters south of 55°47'N latitude, reduces the likelihood of intercepting herring migrating from spawning grounds to the

north while increasing enforcement efficiency. Alternative (b), permitting the fishery to occur anywhere in the FCZ increases the likelihood of intercepting herring migrating from spawning grounds to the north and decreases enforcement efficiency. Alternative (c), prohibiting a summer herring fishery in the FCZ, would not provide any increase in protection since the current fishery now occurs almost entirely in state waters and could readily harvest the entire amount of herring permitted under State regulations. The provision that allows for emergency closure of the FCZ provides adequate protection in the event that a conservation problem is identified.

2. Establishment of time/area closures during the sac-roe fishery.

The sac-roe fishery occurs when herring move inshore during the spawning period. This period occurs in April and May in Bristol Bay and in May and June in Norton Sound. Two alternatives were considered for time/area closures.

(a) Closure of the FCZ to herring fishing during the sac-roe fishery as proposed in the FMP.

The FMP proposes to close the FCZ to directed herring fishing from April 1 to June 30. On July 1 the FCZ south of 55°47'N latitude will open and when 2,000 mt has been taken in the combined state/federal area the FCZ will close automatically.

(b) Open the FCZ, or a portion thereof, to herring fishing during the sac-roe season.

This alternative would permit the harvest of herring offshore year-round including during the period when schools might be concentrated and vulnerable on their inshore migration but when product quality would be inferior.

Environmental Impact

The preferred alternative (a) would be more beneficial to the herring resources by reducing the potential for a mixed-stock fishery. Inshore stocks during the sac-roe season form discrete units that can be managed more effectively than would be possible if offshore fisheries were allowed during this period.

The 55°47' boundary was chosen to complement current state regulations which allow trawling south of that line during the summer. Since 1980 a food/bait fishery has developed in the Dutch Harbor area and although this fishery has taken place entirely in state waters, there is no need to restrict it to state waters. This measure will eliminate a potential conflict between state and federal regulations.

3. Apportionment to the Winter Domestic Food and Bait Fishery.

As soon as practicable after completion of the inshore commercial and subsistence fisheries, the Council, upon the recommendation of the PMT, shall propose determinations of ABC and winter apportionment of OY for implementation by the NMFS Alaska Regional Director. These values shall be calculated according to the provisions of Section 10 of the FMP. Any winter apportionment to the domestic offshore fishery shall be made on or before September 30, or as soon as is practicable thereafter. The Council considered three alternatives wth respect to this apportionment.

(a) Allowing less than the entire remaining ABC to be taken in the FCZ as proposed in the FMP.

The proposed OY procedure states that OY consists of three components: AIC, a summer apportionment, and a winter apportionment. The AIC and summer apportionments will not vary substantially from year to year unless groundfish or herring stocks change significantly. The winter apportionment of OY, however, has the potential to vary from zero to 10,000 mt depending not only on herring abundance but also the degree of utilization by the preceding fisheries. The amount of this winter

apportionment will not be allowed to exceed 50% of ABC. The Council has made this adjustment based on socioeconomic factors rather than out of biological necessity. The available scientific information indicates that the procedures for determining ABC are adequate to prevent overfishing even if the entire ABC is taken in a mixed-stock fishery. However, due to the need for increased availability of herring to subsistence users and to address the fears of inshore commercial fishermen, the FMP states that only one half of ABC, after the preceding harvests and adjustments have been subtracted, will be made available for harvest in the FCZ.

This procedure will promote more rapid rebuilding in cases where the annual spawning biomass level is less than the MSY biomass level. The management measures for the FCZ herring fisheries are intended to minimize the effects of mixed-stock fishing. The FMP recognizes that federal regulation cannot prevent overfishing in waters managed by the State of Alaska. However, to the extent possible, management under the FMP will promote coordination in management of the herring resource throughout its range.

(b) Allowing the entire remaining ABC to be taken in the FCZ.

Earlier drafts of the FMP would have allowed the entire ABC (or any remaining ABC after the preceding fisheries) to be taken in the winter FCZ fishery. The controversy surrounding the question of mixed-stock herring fishing has been fueled by lack of definitive data. ABC, as defined in the FMP, applies to the combined state/federal herring resource and by definition is an acceptable catch. The downward adjustment and limitations in the determination of OY are therefore socioeconomic in nature.

This alternative would provide for at least a two-fold increase in the winter offshore harvest over the proposed action and would, under certain conditions, provide for harvests in excess of 10,000 mt. It would permit apportionment of less than 2,000 mt.

(c) Prohibit a directed offshore herring fishery under any circumstances.

This alternative would prohibit offshore herring harvests even in those years when the inshore sac-roe harvest was low for reasons other than reduced herring abundance. Low harvests could occur as a result of weather, ice, or poor market conditions. Also, if herring abundance increased beyond the capacity of the inshore fishery to harvest and/or process herring, a surplus of herring could remain.

Environmental Impact

Prohibiting a directed offshore herring fishery under any conditions [alternative (c)] may provide maximum protection for the herring fishery; however, alternative (a) is preferred because it provides adequate protection against overfishing of discrete stocks in the offshore mixed-stock fishery, while providing for an offshore harvest when the inshore sac-roe harvest is low for reasons other than herring abundance. Additionally, because natural mortality of herring has been estimated between 0.30 and 0.40, the benefits of prohibiting an offshore fishery would be considerably reduced.

Selection of alternative (b) would probably not result in overfishing of small discrete stocks even if they had been fully exploited during the spring sac-roe fishery because only the sexually mature portion of the population is subjected to harvest during that fishery and because it is improbable that a stock would be harvested offshore in amounts substantially different than its proportion of the total population. Never-theless, because of the present lack of information with respect to the offshore distribution of herring and because of the importance of certain small stocks to western Alaska villages, the Council selected a more conservative approach.

D. Proposals and alternatives concerning directed foreign harvest of herring.

Both the Soviet Union and Japan began to harvest eastern Bering Sea herring in the 1960s when western Bering Sea herring populations declined as the result of overfishing. This fishery peaked in 1970 with a catch of over 145,000 mt and then declined rapidly, apprarently due to a series of weak year classes. Although herring populations began to increase in the mid-1970s, harvest restrictions were implemented as the result of passage of the Magnuson Act and in 1980 herring were declared a prohibited species. The Council considered two alternatives with respect to an apportionment to directed foreign herring fishery.

1. No TALFF under any circumstances.

This alternative would preclude a directed foreign herring fishery even if the domestic fishery failed to harvest the full offshore apportionment. This is the proposed and the preferred alternative.

2. Apportionment to TALFF when domestic fishery failed to harvest the full offshore apportionment.

This alternative would require an annual survey of domestic and joint venture processors for the purpose of determining their intent and capacity to process herring and apportionment to TALFF of any surplus as well as a January reapportionment of any DAH which would not be harvested during the remainder of the fishing year.

Environmental Impact

Since the offshore apportionment will be limited to no more than 10,000 mt, it is apparent that domestic and joint venture processors will process the entire amount. Therefore, the environmental impacts of these two alternatives are essentially the same.

IV. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. Biotic Environment

1. General

The marine environment affected by the fisheries allowed under this FMP includes all waters in the FCZ from the southern part of the Chukchi Sea to the Aleutian Islands and those waters south of the Aleutian Islands, west of 170° West longitude. The primary fish species under consideration is the Pacific herring, Clupea harengus pallasi, which occurs throughout the management unit.

The Bering Sea is located between approximately 160° east longitude and 160° west longitude; and between approximately 52° north latitude and 65° north latitude. It is bounded on the east by the Alaska mainland; on the west by the Siberia mainland and the Kamchatka Peninsula; on the south by the Alaska Peninsula, the Aleutian Islands, and the Commander Islands; and on the north by the Bering Strait.

The area of the Bering Sea is about 2.3 million square kilometers. Of this area, 44 percent consists of continental shelf; 13 percent of continental slope; and 43 percent of deepwater basin. The continental shelf of the northeastern Bering Sea is one of the largest in the world. It is extremely smooth and has a gentle uniform gradient. The continental slope bordering this shelf is abrupt and very steep, and is scored with valleys and large submarine canyons. On the south, the Aleutian/Commander Islands Arc forms a partial barrier between the Bering Sea and the Pacific Ocean. This chain consists of more than 150 islands, and it is about 2,260 kilometers long. The continental shelf of the Aleutians is narrow and discontinuous, with a breadth ranging between 4 kilometers and 46 kilometers. The broader parts of this shelf are in the eastern Aleutians. The Aleutian Trench, a large canyon stretching from the central Gulf of Alaska to the Kamchatka Peninsula, adjoins the Aleutian/ Commander chain on the south.

Bowers Bank is a submerged ridge extending to the northwest from the westcentral Aleutians into the Bering Sea. It is about 550 kilometers long and 75 to 110 kilometers wide, increasing in width as it approaches the continental shelf of the Aleutians. The summit of the ridge is 150 to 200 meters deep in the south, 600 to 700 meters deep in the center, and 800 to 1,000 meters deep in the north.

Aside from the Aleutians and Commanders, the Bering Sea has relatively few islands. The very small Pribilof and St. Matthews Island groups lie adjacent to the continental slope of the northeastern Bering Sea. Nunivak Island lies just off the Alaska mainland between the Yukon and Kuskokwim deltas. St. Lawrence Island lies in the northern part of the Bering Sea, between Norton Sound and the Chukchi Peninsula.

Water flows into the Bering Sea from the Pacific Ocean and from the rivers and surface of the adjoining land areas. Water moves from the Bering Sea into the Arctic Ocean through the Bering Strait. Thus, there is a net movement of water northward throughout the Bering Sea. On the eastern Bering Sea continental shelf, the dominant movement of water involves water entering the Bering Sea from the Pacific in the area of Unimak Pass. This water moves northward to St. Matthews Island and eastward toward Bristol Bay. Dividing near St. Matthews Island, the northward stream reunites and passes through the Bering Strait.

Except for the southernmost part, which is in the temperate zone, the Bering Sea has a subarctic climate. It experiences moderate to strong atmospheric pressure gradients, and is subject to numerous storms. Pack ice covers most of the continental shelf of the northeastern Bering Sea during winter and spring, intruding into the northern Bering Sea in November and reaching its maximum extent in late March, when the ice edge may be south of the Pribilof Islands and as far west as Unimak Island. The more southerly area of the continental shelf between the Pribilofs and Unimak Island, and the deepwater basin area, are usually ice free throughout the year because of the intrusion of warmer water from the Pacific. In April and May, the ice begins to retreat, and the Bering Sea is usually free of ice by early summer.

Although the responsible natural processes are not completely understood, the physical features of the Bering Sea that have just been described combine to create conditions that are very favorable for biological production. During the cold winter months, there is a buildup of nutrients. The mixing of Pacific and Bering Sea water produces an upwelling of these nutrients along the Aleutian Chain, and the broad continental shelf of the northeastern Bering Sea provides a favorable habitat for plants and animals that consume those nutrients either directly or indirectly through a complex food web. The Bering Sea, Chukchi Sea, and Aleutian Islands form a unit which is very productive biologically and supports about 300 species of fish and some of the largest populations of birds and marine mammals in the world.

Herring concentrate on winter feeding grounds north of the Pribilofs and little is known about the ecology of the herring during this phase. The extent of movement of stocks from nearshore to offshore feeding grounds is also not well established, nor is the degree of mixing of spawning stocks in the offshore areas. Stock assessment techniques for the inshore spawning stocks have been developed by ADF&G. The best available information indicates that herring stocks are recovering from an apparent decrease in abundance which was evident during the late 1960s to the early 1970s. Stock assessment surveys, scale analysis and tagging programs in the offshore area have been proposed as research priorities. Further information on the biological and environmental characteristics of the area and the stocks is to be found in Sections 7.0 and Appendix 2 of the FMP and Section 5 of the Bering Sea/Aleutian Islands Groundfish FMP (NPFMC, 1979).

2. Marine Mammals and Herring

Information on distribution, migration, abundance and feeding habits of marine mammal species is discussed in Appendix 2 of the FMP. The marine mammal fauna of the Bering Sea is quite diversified, including representatives of the order Carnivora (suborders Fissipedia and Pinnipedia) and the order Cetacea (suborders Odontoceti and Mysticeti). Species which are known to occur in the area under discussion include the following:

Order CARNIVORA

Suborder FISSIPEDIA

Sea otter, Enhydra lutris (Linnaeus)

Suborder PINNIPEDIA

Northern sea lion, Eumetopias jubata (Schreber)

Northern fur seal, Callorhinus ursinus (Linnaeus)

Walrus, Odobenus rosmarus (Linnaeus)

Harbor seal, Phoca vitulina (Linnaeus)

Spotted seal, Poca largha

Ringed seal, Phoca hispida (Schreber)

Ribbon seal, Phoca fasciata (Zimmerman)

Bearded seal, Ergnathus barbatus (Erxleben)

Order CETACEA

Suborder ODONTOCETI

Bering sea beaked whale, Mesoplodon stejnegeri (Ture)

Goose-beaked whale, Ziphius cavirostris (Cuvier)

Sperm whale, Physeter macrocephalus (Linnaeus)

Killer whale, Orcinus orca (Linnaeus)

Dall porpoise, Phocoenoides dalli (True)

Harbor porpoise, Phocoena phocoena (Linnaeus)

Beluga, Delphinapterus leucas (Pallas)

Suborder MYSTICETI

Bowhead whale, Balaena mysticetus

Gray whale, Eschrichtius robustus

Humpback whale, Megaptera novaeangliae (Borowski)

Sei whale, Balaenoptera borealis (Lesson)

Fin whale, Balaenoptera physalus (Linnaeus)

Minke whale, Balaenoptera acutorostrata (Lacepeda)

Blue whale, Balaenoptera musculus

Right whale, Balaena glacialis

Distributions of these mammals are influenced by a number of factors including the seasonal ice regime, location of the Bering Shelf break,

water depth, seasonal sea temperatures, and others. The Bering Sea is almost equally divided into a deep southwestern half and the shallow northern and eastern half. These halves support different marine mammal faunas. In the Bering Sea, herring are mainly associated with the shelf, the shelf break and the coastal zone.

Of the marine mammals previously listed, the following are known or suspected predators on herring:

Toothed Whales: Dall porpoise, Harbor porpoise, Beluga whale, Killer whale

Baleen Whales: Humpback whale, Blue whale, Sei whale, Minke whale, Fin whale

Pinnipeds: Northern fur seal, Harbor seal, Spotted seal, Ribbon seal, Ringed seal and Northern sea lion

Toothed Whales

Of the toothed whales, the Dall porpoise may be one of the more abundant in the Bering Sea, particularly in the deeper parts. It ranges into the Chukchi Sea in summer. Near northern Japan these porpoises are most abundant in early February. Dall porpoises were not sighted in the southeastern or central Bering Sea during several shipboard cruises and aerial surveys undertaken between February and May. However, they were of common occurence south of the Aleutian Islands and Alaska Peninsula during those months. Herring are an important food of Dall porpoises in the eastern North Pacific. These fish are probably not very important in the Bering Sea as the porpoises are not present during months of relatively cold water (November to April) when herring are concentrated at and near the shelf break. In months of warmer water temperatures (May to October), herring are concentrated near shore where few Dall porpoises are observed. Based on known food habits of these porpoises in other areas, those in the Bering Sea probably depend most heavily on squid and walleye pollock.

Harbor porpoises occur in the Bering Sea during mid to late summer. They are infrequently taken in salmon gillnets during July and August in Norton Sound. Reported sightings by coastal residents are infrequent and it appears that they are probably not numerous north of the Alaska Peninsula. Foods of harbor porpoises are pelagic and semidemersal fishes including herring, capelin, mackerel, sardines, gadids and small salmonids. Herring are an important food in some areas and it has been reported that in the Bay of Fundy, movements of herring and harbor porpoises were similar. In the eastern Bering Sea, harbor porpoises are probably excluded by low water temperatures for most of the year and are not numerous. They have not been seen in association with spawning concentrations of herring in Norton Sound during late May and early June, shortly after the ice disappears. However, they have been seen in association with spawning capelin in early July. Food remains in one harbor porpoise entangled in a salmon net near Nome, Alaska, in mid-July included mainly saffron cod with some remains of herring and crangonid shrimps. They probably utilize herring which remain in the coastal zone after spawning. Other food species such as capelin, saffron cod and boreal smelt are probably of greater importance.

Beluga whales are year-round residents of the Bering Sea. Their greatest abundance there occurs in November through about mid-April. A major part of the population migrates north to summer in the Chukchi and Beaufort Seas. During months when ice is present in the Bering Sea, these whales are widespread and no unusual concentrations have been reported in the herring wintering areas. In late spring, a portion of the Bering Sea population of beluga moves into the coastal zone, frequenting bays, lagoons and river mouths from Bristol Bay to Bering Strait. They remain in the coastal zone at least through mid-August. Herring, as well as a variety of other fishes, are recognized as important foods of beluga whales in some regions during ice-free portions of the year. In the Bering Sea, belugas are often observed in association with spawning concentrations of herring. Frost summarized published information about the foods of belugas in Alaska. In Bristol Bay, the five species of salmon, smelt, flatfish, sculpins, blennies, lamprey, shrimps and mussels were consumed. Smelt were the main food in early May and outmigrating

salmon smolts were important in late May. During July and August adult salmon were the main prey. Lowry found that belugas from the northern Bering and southern Chukchi Seas fed mainly on saffron cod. Sculpins, herring, octopus, smelt and eelpouts were of lesser importance. Comparing the seasonal distribution and abundance of herring in the Bering Sea with that of belugas, it appears that herring may be a locally important food of belugas. In general they are probably of lesser importance than salmon, smelt or saffron cod.

Marine mammals are generally considered to comprise the bulk of the diet of killer whales. However, some investigators consider killer whales an important predator on herring also.

Baleen Whales

Baleen whales which interact to a greater or lessor extent with herring in the eastern Bering Sea include the humpback gray, blue, sei, fin and minke whales. Most of these depend largely on prey other than fishes.

Humpback whales occur in very low numbers during the summer in the Bering Sea. They utilize shallow coastal waters and waters around oceanic islands. In the North Pacific region, they feed on euphausiids, fishes and squids. Fishes, which have been reported as eaten by humpbacks include Atka mackerel (15-30 cm long), pollock, herring, capelin, sand lance, smelt, cod, salmon, rockfish, saffron cod and Arctic cod. In the Bering and Chukchi Seas, humpbacks have been found near aggregations of Arctic cod, capelin and herring. At present, populations of humpback whales in the North Pacific region are severely depleted from over-exploitation. They are currently not food limited.

Sei whales prey mainly on Calanus copepods and to a lesser extent on euphausiids. Fishes and squids are also reported as food, the former including smelt, sand lance, arctic cod, rockfish, greenling, pollock and capelin. Based on this list of fishes ocassionally utilized, it is presumed that sei whales may also occasionally feed on herring.

Minke whales are comparatively euryphagus with a wide array of potential food species. Their summer distribution is extensive and they do not appear to concentrate on the dense aggregations of spawning herring. Rather, it appears that minke whales feed on whatever suitable prey is available where the whales are. Herring are utilized although they may be relatively unimportant to the population as a whole.

Fin whales feed primarily upon euphausiids and copepods but also feed on occasion upon surface schooling fish including herring.

Gray whales are benthic feeders which occur in the Bering Sea from April through October or November. They are not known to feed extensively on fishes, even when dense schools occur where gray whales are present. Foods of gray whales are reported to include benthic amphipods, polychaete worms, small bivalves, gastropods, ascidians, priapulids, isopods, mysids and herring. Herring appear to be a minor item in the diet of gray whales.

The interaction of herring and baleen whales is dealt with further in Annex A to this statement, the biological opinion of the Assistant Administrator on the FMP, issued under Section 7 of the Endangered Species Act of 1973.

Pinnipeds

The Pinnipeds also feed on herring. The food habits of the fur seal have been the most thoroughly studied. In studies previous to 1961, off Southeast Alaska herring contributed more than 50% of all fur seal food and in most cases over 90%. However, in the eastern Bering Sea south of the Aleutian Islands and near Kodiak Island, examination of seal stomachs revealed very few or no herring.

Although little extensive published data is available, herring are considered to be an important component of harbor seals' diet in the coastal area during early summer. Local fishermen indicate that large numbers of harbor seals are associated with schools of herring in the Bristol Bay area during late spring-early summer.

Ribbon seals fed infrequently on herring during the winter and early spring months, according to a survey of seals on the ice front and ice remnants.

Herring are an important component of the diet of spotted seals, especially in open water. The largest coastal aggregations of spotted seals are on top of spawning schools of herring.

Ringed seals feed primarily on mysids, amphipods, euphausiids, shrimps, saffron cod, polar cod, and sculpin, but only occasionally on herring.

Northern sea lions are opportunistic feeders and feed on herring, although pollock comprise the largest percentage of the diet. They are known to congregate on concentrations of spawning and overwintering herring and the importance of herring appears to be high when stocks are concentrated in the nearshore zone.

Sea Birds and Herring Eagles?

Shearwaters, murres, puffins, fulmers, cormorants and gulls are known to feed on herring. The availability of herring as prey depends both upon the season of the year and upon the life stage of the herring. Herring are particularly vulnerable to bird predation during the spring and summer when they are closer to the surface. Because of their size, herring are only available during the early part of their lives to smaller birds such as fulmars and shearwaters, but adult fish are readily consumed by other birds such as murres. Gulls are a major component of egg mortality in intertidal areas.

Socioeconomic Environment

The herring resource has been utilized by four distinct fisheries which are the subsistence fishery, the domestic inshore food and bait fishery, the domestic offshore food and bait fishery, and the foreign fisheries for herring on the high seas. The characteristics of these groups are discussed in Sections 3.0, 6.0 and 9.0 of the FMP.

A study, funded by the Council, on the social and economic impacts of a commercial herring fishery on the coastal villages of the Arctic/Yukon/Kuskokwim area describes the socioeconomic environment of the area in greater detail. This work was prepared by Dames and Moore, Anchorage, Alaska, in September, 1978. The report stressed the importance of herring fisheries socially, economically and nutritionally to villages of the Yukon-Kuskokwim Delta in general and Nelson Island in particular. Local residents were, at that time, opposed to commercial herring fishery development. Since then some members of villages in that area have started fishing commercially in the fishing areas open north and south of the Delta.

In 1978, the State of Alaska passed legislation supporting the policy of protection of the subsistence lifestyle. Although the Assistant Administrator is not subject to this legislation, and will not be promulgating regulations governing the subsistence harvest of the resource, the FMP acknowledges the importance of subsistence user groups and gives priority to the subsistence fishery in its regulation of the offshore fisheries.

The domestic commercial inshore fisheries have developed rapidly. The sac-roe fishery began in 1977 with a harvest of 2,545 mt. The fishery then expanded to harvests of 7,305 mt, 12,406 mt, 21,590 mt, 17,652 mt and 24,845 mt in 1978, 1979, 1980, 1981 and 1982 respectively. The present food and bait fishery in the Aleutian Islands/Alaska Peninsula area began in 1981 with a catch of 704 mt and increased to 3,240 mt in 1982, of which 1,890 mt were for food markets in Japan and Korea. Additionally, joint ventures have for several years expressed considerable interest in harvesting herring as part of their groundfish operations.

Foreign harvest of herring was reduced to an incidental catch in 1977 when the Magnuson Act took effect, and herring became a prohibited species following a court order invalidating regulations implemented under the PMP in 1980.

V. ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTIONS AND ALTERNATIVES

The environmental impacts of the proposed management measures and alternatives were discussed in Chapter III of this Statement. This section summarizes the direct environmental consequences of the herring fishery as it would be conducted under proposed actions and alternatives, with special emphasis on:

(a) the herring population itself,
(b) populations of marine mammals, birds and fish that are predators on herring,
(c) direct stress to the ocean floor environment, and
(d) the discharge of waste resulting from processing of herring products.

The direct impacts on the natural environment result in additional, indirect impacts upon the society and economy of humans that inhabit the area or participate in the fisheries. These indirect impacts are discussed with emphasis on:

(a) subsistence users of herring resources, and
(b) the commercial fishing industry.

The discussion of direct and indirect impacts is followed by discussions of any irreversible or irretrievable commitment of resources that approval and implementation of the FMP might involve, and of the relationship between local short-term uses and maintenance and enhancement of long-term productivity.

Much of the interaction between herring fishing operations and the physical and biological environment occurs within the Territorial Sea managed by the State of Alaska. Potential conflicts between these inshore fishing operations and the environment (marine mammals, for example) discussed in this Statement are provided only for the general information of the reviewer. The direct interaction between offshore fishing operations and the environment are discussed to the extent of the available information. Indirect impacts resulting from offshore herring fishing operations are also discussed. The general conclusion of this Statement is that although the herring population in the FCZ may be reduced significantly from potential abundance levels, the management measures proposed will tend to stabilize abundance at a level near

that which will support MSY. Thus, the direct interaction between herring and herring predators (including inshore fishermen), and the dependence of those predators on the herring resource, will generally be improved and stabilized by the proposed action.

A. Direct impacts on the natural environment.

1. The herring population itself.

Herring populations appear to have recovered from the effects of overfishing in the 1970s, although abundance has fluctuated as the result of differences in year class strengths. However, both the 1977 and 1978 year classes, which entered the fishery as four year old fish in 1981 and 1982, appear strong and these year classes will remain in the fishery for several years. The Council felt, however that a conservative management regime was necessary to maintain herring populations at or near levels that will support MSY and to provide adequate protection for the smaller stocks. The herring population will, therefore, benefit as a result of this plan. Commercial herring fishing will remove a percentage of the population annually; however, the exploitation rate will be markedly reduced when populations are below MSY levels and will in no case exceed 0.20. Most alternatives for the FCZ fisheries that were considered but rejected by the Council would result in a less conservative management regime for the directed fisheries, would provide less protection from incidental harvest, and, therefore, would be less beneficial to the herring population. The Council also considered some radically restrictive management measures that would have preserved herring as a resource solely for subsistence and inshore commercial utilization.

2. Populations of marine mammals, birds and fish that are predators on herring.

(a) Marine Mammals

The impact of the fishery on the marine mammals can only be determined qualitatively at present due to the lack of quantitative data. The

best available information indicates that spotted seals, ringed seals, ribbon seals, bearded seals, walrus, grey whales, humpback whales and killer whales are present in the territorial sea area during spring and late summer at the time the subsistence fishery and inshore commercial fishery would be taking place. An unknown degree of interaction is expected to occur, either by direct competition or by disturbance of the marine mammals. During the winter months, the northern fur seal and northern sea lion are located in the region of the offshore herring fisheries and could be impacted by the high seas fisheries.

In general, when herring are seasonally abundant in the coastal zone, their availability to some marine mammal species is exceptionally high but of relatively short duration. They are intensively utilized by these species during these periods. However, the stocks of herring appear to be large in relation to their importance as food for marine mammals. On the other hand, a possible decrease in stocks of other prey resulting from increased commercial fishery exploitation (e.g., groundfish fishery, etc.) may increase the importance of other prey species and affect the overall ecosystem. This may be one explanation why fur seals did eat herring in the early 1960's, but not the 1970's. It is not known if the earlier consumption occurrences for fur seals were atypical or indicate a shift in diet resulting from overfishing of herring stocks by the Japanese and Soviets in the late 1960's.

A small number of ribbon seals are taken each year by Alaskan natives for subsistence use, and harbor seals are subjected to substantial hunting pressure. Japanese vessels in the groundfish fishery took 5 fur seals from 1973-1979. A similar number would be expected to be caught incidentally to high seas domestic fishing operations if they developed to a similar level in the future. Some sea lions are believed to be taken in gill net operations in Bristol Bay, but the numbers are believed to be very low. (1 sea)

Section 7 consultations requested of the National Marine Fisheries Service conclude that approval and implementation of the FMP is not

likely to jeopardize the continued existence of any threatened or endangered species or critical habitat of such species (ANNEX A).

Although commercial herring fisheries in the FCZ might compete to some extent with marine mammals, the measures proposed in the FMP are designed to increase and then to stabilize herring populations with resulting beneficial impacts on those mammals that feed on herring. More restrictive herring management measures would have greater benefit for these mammals, while less restrictive measures would provide lesser benefits. The management measures proposed include procedures for determining OY which give priority to inshore fisheries and therefore decrease the likelihood of disturbing marine mammals offshore, especially those which might be attracted to concentrations of herring. The opposite would be true of any alternative which would give allocation priority to offshore fisheries.

(b) Birds

Large numbers of sea birds inhabit the Bering and Chukchi Seas and many of these feed on herring when available. As in the case with marine mammals, since the proposed FMP is designed to increase and eventually stabilize herring populations, birds that are predators on herring will benefit. Any less conservative alternative would benefit these birds less. While more conservative alternatives might provide more benefits to these birds, such benefits could be offset by adverse impacts to the birds resulting from disruption of offshore trawl fisheries. There is evidence that many such birds are heavily dependent on the waste from such fisheries as a highly available food source.

(c) Fish

It is not possible to quantify the degree of herring predation that occurs with respect to other fishes in the Bering and Chukchi Seas except to recognize that herring comprise a large component of the trophic level that converts plankton to fish flesh. Therefore, the

increase in herring populations expected to result from implementation of the FMP should be beneficial to fish populations as a whole. As in the case of marine mammals and birds, the conservative management measures proposed in the FMP will be more beneficial to predatory fish than less conservative measures, although more conservative measures would probably be more beneficial to them.

3. Direct stress to the ocean floor environment.

Because of its great size, trawl gear that is dragged along the ocean bottom in the manner that has traditionally been used in the Bering Sea and Aleutians is bound to cause significant stress to benthic marine life. In contrast with the level of incidental harvest, which can be calculated from observer reports, the extent of damage to the ocean bottom environment and the creatures that dwell there but are not actually captured is difficult to assess. It is known that crabs in their soft shell stage are extremely vulnerable to harm from trawl gear, as are halibut. Disturbance of the ocean floor may also adversely affect species that are not directly utilized by humans, but are preyed upon by species that are of commercial or subsistence importance. Because populations of the latter species in the Bering Sea and Aleutians are generally healthy, except where they have been directly overharvested, any adverse effects that they may have suffered from disturbance of the ocean floor during the last two decades of bottom trawling in the region do not seem to present a major problem. Nevertheless, the exact extent of any such adverse effects should be the subject of further investigation.

Measures that would reduce the disturbance of the environment of the ocean floor by groundfish trawl operations include a requirement for the use of off-bottom trawls similar to that which applies during certain periods in the Gulf of Alaska, and time/area closures designed to protect the more vulnerable benthic resources.

It is expected that herring fishing operations will be in conjunction with groundfish trawl operations. The degree of additional stress which may result from a directed offshore herring fishery is not measurable at this time but is expected to be negligible.

4. The discharge of waste resulting from the processing of herring products.

The waste expected to be produced by the offshore herring fisheries is minimal. Economics require that product recovery be maintained at a very high rate so waste is very small. What waste there is is dispersed in such amounts as to be insignificant in the vastness of the Bering Sea. There is, therefore, no discernible difference among the proposed measures and alternative measures relevant to the discharge of waste products.

OK, but could be read as inconsistent with IV.A.2.b. could use explanation

B. Indirect Socioeconomic Impacts

1. Subsistence users of herring resources.

Commercial fishing, as permitted under the FMP, will remove a percentage of the herring biomass annually and a small percentage of those fish will no longer be available for harvest by subsistence users. However, several of the management measures contained in the FMP provide protection of subsistence harvests. Both the incidental catch limitations, which provide an incentive for fishing vessels participating in offshore groundfish fisheries to avoid the incidental catch of herring, and the Herring Savings Area, which, when implemented, further reduces the incidental catch of herring, contribute to maintenance of herring resources at a level that will support traditional subsistence harvests. The allocation procedure itself places a lower priority on offshore mixed-stock fisheries which have the potential of overfishing discrete stocks harvested by the subsistence fishery. The conservative management regime adopted in the FMP with respect to procedures for estimating biomass, the use of the lower range of estimates and the procedures used to determine the offshore winter apportionment of OY, will benefit subsistence users. The Nelson Island herring stock has been identified as the most critical for subsistence purposes and the FMP, complementing state regulations which prohibit commercial herring fishing in that area, assigns a zero exploitation rate for that stock in the calculation of the winter offshore apportionment. An additional subsistence adjustment is also made.

The alternative measures rejected by the Council which provide less protection against incidental harvest and promote a less conservative management regime could lead to reduction of stocks with subsistence importance. The Council rejected extremely protective management measures proposed by Alaska Native subsistence users of herring which would undoubtedly have assured protection of herring stocks from all but natural hazards and subsistence and limited inshore commercial use. The data before the Council (see, e.g., Sections 3.3 and 7.6 of the FMP) indicated that such restrictive measures were unnecessary for protection of even small spawning stocks that are utilized for subsistence.

2. The commercial fishing industry

Although allocations to commercial herring fisheries may be smaller than they would be under a less conservative management regime, the long-term effect on these fisheries is beneficial. A less conservative management regime would permit larger allocations initially, but would risk drastically reduced allocations in the future.

The procedures for determining the winter offshore apportionment, particularly the procedures of dividing any surplus in half and limiting any apportionment to no more than 10,000 mt, will sharply limit the amount of herring taken offshore and, therefore, will negatively impact those fishermen and processors that participate in the fishery. The Council felt, however, that such conservative measures were appropriate in order to provide adequate protection for small discrete stocks in the offshore mixed-stock fishery.

Although, under the alternative selected by the Council there would be no apportionment to TALFF, it is clear that domestic and joint venture processors will be able to process the entire directed offshore herring harvest, especially since it will be limited to no more than 10,000 mt, and therefore no foreign apportionment would result regardless.

Under the management measures proposed in the FMP, offshore groundfish fisheries will be negatively impacted economically to some degree if the

AIC is exceeded and/or if the Herring Savings Area is closed. Alternative measures, rejected by the Council, would reduce this impact, while uniform annual closure of the Herring Savings Area would increase the impact. The measures proposed are not expected to prevent any nation from harvesting its groundfish allocation, or to preclude the attainment of OY.

C. Irreversible and irretrievable commitment of resources.

There will be no long term irreversible and irretrievable commitment of biological resources when this plan is implemented. Management of a renewable resource is self-destructing if a long-term irreversible commitment of resources is made. No irreversible commitment of water, air, land or energy resources have been identified.

Short-term financial and administrative resources will be committed to monitoring the fishery and the resource. This is discussed further in Sections 12.6, 12.7 and 12.8 of the FMP. Recommendations have also been made for further research.

D. Relationship between local short-term uses and maintenance and enhancement of long-term productivity.

The maintenance and enhancement of long-term productivity is fundamental to the goals of fishery management. The objectives of the FMP were described in its consideration of the National Standards (see Section 12.1 of the FMP). Maximum sustainable yield and optimum yield are calculated in light of long-term requirements and goals while taking account of short-term developments. Coordinated monitoring of the fishery and the condition of the resource will sometimes result in in-season management actions. These actions will be taken according to specific criteria and will be in harmony with overall long-term objectives.

VI. IMPACT OF THE PROPOSED ACTION ON PLANS AND POLICIES FOR THE AFFECTED AREA

A. Coastal Zone Management Act

According to the requirements of Sections 305 and 306 of the Coastal Zone Management Act of 1972 (CZMA), the State of Alaska submitted a Coastal Management Program that was approved by the Assistant Administrator for Coastal Zone Management, NOAA, in July 1979. Under CZMA, Section 307(c)(1), Federal activities directly affecting the coastal zone must be consistent to the maximum extent practicable with the State's approved coastal management program. A determination of the consistency of the FMP with the Alaska Coastal Management Program has been submitted to the Alaska Office of Coastal Management pursuant to Section 307. The State has not concurred that implementation of the FMP would be consistent with the Alaska Coastal Management Program.

B. State of Alaska Board of Fisheries

The Board is responsible for the management and regulation of fisheries under the jurisdiction of the State of Alaska. The FMP proposes a management process whereby the biological assessments, public input, and decision-making processes of the Council, the Board, and the Assistant Administrator would be coordinated, and regulations under the FMP and of the Board would, to the extent feasible, be in harmony. Certain regulations or harvest levels prescribed by the Board may, however, conflict with the National Standards or individual management measures of the FMP.

C. Marine Mammal Protection Act (MMPA)

Twenty-four species of marine mammals are found in some regions of the Bering Sea, Chukchi Sea and Aleutian Islands area covered by the FMP during some months of the year: northern sea lion, northern fur seal, harbor seal, spotted seal, ringed seal, ribbon seal, bearded seal, walrus, sea otter, minke whale, beluga, Dall porpoise, harbor porpoise, killer whale, giant bottlenose whale, Bering Sea beaked whale, blue whale, sei whale, fin whale, right whale, sperm whale, humpback whale, gray whale, and bowhead whale. The latter eight

species have been classified as endangered species. None of these species is present in all areas covered by the FMP and during all months throughout its range, and therefore, its position within the ecosystem will vary seasonally and spatially. In addition, any effects upon the ecosystem of the herring fisheries will vary according to the size and extent of each of the fisheries managed or described by the FMP: the inshore subsistence herring fishery, the inshore domestic commercial fishery including the spawn-on-kelp herring fishery, the offshore domestic herring fishery, and the foreign and domestic catch of herring incidental to commercial groundfish trawl operations.

The sea otter often feeds in the intertidal zone where the spawn-on-kelp herring fishery occurs, although only in the southernmost area of this fishery. Because herring spawn are found in the Bering Sea on macroalgae, such as Fucus and Laminaria, a change in the density and abundance of these plants by the spawn-on-kelp herring fishery may affect the ecosystem of which sea otters are a part, in addition to any effects upon the herring resource itself.

The following species of marine mammals may occur within some area where the subsistence herring fishery occurs in the spring following ice breakup: spotted seal, ringed seal, ribbon seal, bearded seal, walrus, gray whale, humpback whale, bowhead whale, killer whale, and beluga. These same marine mammal species also occur in the same area of coastal territorial waters where the domestic roe fishery occurs. The northern seal lion, harbor seal, harbor porpoise and sea otter will also be found in the Bristol Bay area during the summer in coastal waters where the herring fishery occurs. Some interaction by the fishery with some of these marine mammal species may be expected to occur and will have some effect upon the ecosystem, either through competition for the herring resource or by direct impact by mortality or disturbance of the marine mammals.

The following marine mammal species generally occur in the area covered by the FMP where the offshore directed herring fishery occurs: northern fur seal, northern seal lion, minke whale, fin whale, humpback whale, sperm whale, right whale, Dall porpoise, giant bottlenose whale and Bering Sea beaked whale during the summer months of the herring fishery; the gray whale during the

spring and fall migration periods north; the killer whale probably all year; and the beluga and perhaps the bowhead whale during the winter in the region of the offshore fisheries.

Some competition for the herring resource may occur between the fishery and the following marine mammal species: northern sea lion, northern fur seal, harbor seal, spotted seal, ribbon seal, ringed seal, humpback whale, killer whale, harbor porpoise, Dall porpoise, beluga, minke whale, and fin whale. Some impact by either domestic or foreign commercial fisheries in general resulting in either incidental mortality of marine mammals or damage to fishing gear is anticipated based on knowledge of feeding patterns for the following marine mammal species: northern sea lion, northern fur seal, Dall porpoise, harbor seal, ribbon seal, spotted seal, harbor porpoise, and beluga. In addition, the spotted seal, humpback whale and bowhead whale are known to respond adversely to disturbance or harassment. The FMP contains further information for each species.

In general, when herring are seasonally abundant in the coastal zone, their availability to some marine mammal species is exceptionally high but of relatively short duration. They are intensively utilized by these species during these periods. However, the stocks of herring appear to be large in relation to their importance as food for marine mammals (Burns, pers. comm.). On the other hand, a possible decrease in stocks of other prey resulting from increased commercial fishery exploitation (e.g., groundfish fishery) may increase the importance of other prey species and affect the overall ecosystem. This may be one explanation why fur seals did eat herring in the early 1960's but not the 1970's. It is not known if the earlier consumption occurrences for fur seals were atypical or indicate a shift in diet resulting from overfishing of herring stocks by the Japanese in the late 1960's.

The MMPA calls for an integrated ecosystem approach to management in order to conserve marine mammals at optimum sustainable population levels. The FMP has briefly discussed the ecosystem and the place of herring and marine mammal populations in that ecosystem, but it must defer detailed consideration of herring stocks in the context of the ecosystem until the fundamental conceptual analysis of management of the ecosystem is more advanced. Preliminary

work is being done to locate available data to determine their quality in order to initiate the necessary analysis needed for an integrated ecosystem approach to management.

The data on marine mammals presented in this FMP represent the current state of knowledge available at present, however, so much more research must be done to improve the state of knowledge on marine mammals and their many relationships within the Bering Sea/Chukchi Sea ecosystems. This is necessary to provide adequate information to answer the many questions which remain. The use of ecosystem models would be beneficial and help to improve our understanding of the complex interrelationships among marine mammals, their prey, and fisheries within the ecosystem framework. This work is possible and would improve the state of knowledge if such research, including the development and use of ecosystem modeling, were funded to permit a fully integrated ecosystem approach to fishery management.

D. Endangered Species Act of 1973 (ESA)

The area covered by the FMP in the Bering Sea, Chukchi Sea and Aleutian Islands region is frequented by eight species of mammals, all of them whales, that have been listed as endangered pursuant to Section 4 of the ESA. These are the blue whale, Balaenoptera musculus; bowhead whale, Balaena mysticetus; fin whale, Balaenoptera physalus; gray whale, Eschrichtius robustus; humpback whale, Megaptera novaeangliae; right whale, Balaena glacialis; sei whale, Balaenoptera borealis; and sperm whale, Physeter macrocephalus. However, not all of these species are found in regions covered by the FMP in which herring occur in significant numbers.

No critical habitat for any of these species has been designated in this area pursuant to Section 7 of the ESA and 50 C.F.R. Section 402.05.

Primary potential sources of impact by the herring fisheries include: (1) direct disturbance of and physical contact with these catecean species, causing physical injury or death or interfering with nursing or feeding; and (2) competition with these species for the herring resource upon which they feed.

Two of the listed species, the blue whale and the sei whale, primarily occur pelagically beyond the continental shelf and slope areas where herring are not found. Moreover, in this region they feed respectively upon pelagically distributed euphausiids and copepods, neither of which are harvested. Consequently, it is highly unlikely that these two species will be affected either by the direct disturbance of or by competition with herring fishing operation.

The remaining six listed species do occur in at least some portion of the area on the continnental shelf and slope. Gray, humpback, bowhead and fin whales are the species most likely to be found in or near coastal waters where herring spawn, and neither the subsistence or domestic roe herring fisheries occur. Right whales are currently extremely rare, having a population of roughly 200 for the entire North Pacific. There have been sightings in the 1960's south and southeast of the Pribilof Islands. Sperm whales are primarily associated with the continental slope and offshore.

With respect to herring fishing operations directly disturbing these six species, each of the herring fisheries must be considered separately. The spawn-on-kelp herring fishery occurs only in the intertidal zone where whales do not occur and no direct disturbance is expected. The domestic roe herring fishery occurs at present and under the FMP, only within territorial state waters (three mile limit). The subsistence herring fishery also occurs exclusively within state territorial waters. Gray, bowhead and humpback whales might be found within these inshore coastal waters in certain regions and months. Fin whales are found in adjacent offshore waters in Bristol Bay where these two fisheries do not presently occur, but could if expansion into the FCZ were permitted. The offshore domestic herring fishery and the domestic and foreign AIC and PSC would occur in offshore waters of the FCZ where sperm, fin, gray and humpback whales may be found at certain times of the year. Right whales, although not sighted for years, would also be found in these waters if present. The summer FCZ herring fishery will be restricted to waters south of 55°47'N latitude while the winter offshore herring fishery will most likely occur in waters northwest of the Pribilof Islands. Bowhead whales occur only peripherally to the waters of this fishery, being more numerous to the north and west of the prime groundfish area between Unimak

Pass and the Pribilof Islands. The proposed Herring Savings Area closure would help minimize any possible disturbance of these whales by fishing vessels during winter months especially when the ice front is furthest south.

If the subsistence fishery remains at present levels, as expected, it is unlikely to have an adverse impact on these species of whales. Seventy-four percent of the annual harvest of the subsistence fishery occurs in the Eastern Bering/Chukchi Sea region in the area near Nelson Island, usually during a period of a few days immediately following ice breakup (late May-early July), and probably precedes the arrival of gray whales in June-July. Therefore, there should be minimal impact upon the gray whale by the subsistence herring fishery. The bowhead whale passes by the Seward Peninsula and Kotzebue Sound in May, but only trace amounts of the annual harvest of the subsistence herring fishery are caught by fishermen in this area, and thus there should be minimal impact upon the bowhead whale. Neither the size of the vessels nor types of gear currently used by the subsistence herring fishery should affect either the gray or bowhead whales directly, especially as neither whale species consumes herring as a principal food, and thus they should avoid interactions. Furthermore, the bowhead whale avoids areas of noise or disturbances, so given the present limited size of the fishery, there should be no adverse impact. The subsistence fishery in the Bristol Bay area also forms a very small fraction of the total annual herring harvest in the Bering/Chukchi Sea region. Likewise, this subsistence herring fishery should have no adverse impact upon the gray whale in this area. There may be approximately 200 humpback whales in the eastern Bering Sea during the summer months, and not all are expected within the waters where subsistence herring fishing occurs. Humpback whales may eat herring, and could be present when fishing occurs. However, given the present size of the fishery in this area, which is not expected to increase, no adverse impact due to disturbance is expected by this fishery.

The inshore commercial roe fishery is currently primarily found in the Togiak region of Bristol Bay, with smaller harvests occurring northward to Norton Sound. This fishery is restricted in other coastal regions, such as the Yukon/Kuskokwim region, to protect the subsistence fishery. For the same reasons as the subsistence fishery, the commercial roe fishery probably has no

adverse impact on the bowhead whale, as there is little overlap of the range of this whale and this fishery at present levels. Also, the FCZ is closed to herring fishing from April 1 to July 1, when either bowhead, gray, humpback or fin whales would be found in waters where this fishery might occur if it expanded into the FCZ. Only gray or humpback whales may be expected in the Togiak region in the spring/summer months when the domestic roe fishery occurs. For the same reasons as the subsistence fishery, the inshore commercial fishery probably has little adverse impact on these whales. However, expansion of this fishery in number of vessels or area covered might have an impact on the humpback whale which may eat herring and be competing for the same waters. The types of fishing gear currently in use are not expected to have an adverse impact upon these whales.

The summer domestic herring fishery presently occurs primarily within state waters, but, under the provisions of the FMP, can expand into the FCZ south of 55°47'N latitude. In 1982, six processors, seven tenders, seven seiners, one gillnetter and three trawlers registered for this fishery. Although gray, humpback, sperm and fur whales may inhabit these waters during the period the fishery occurs, disturbance is not expected to be significant. Although the humpback whale feeds on herring, the limited size of the summer apportionment (2,000 mt) precludes a significant impact.

The present perceptions of scientists who have examined other harassment situations are that fishing vessels operating in open waters are unlikely to have an adverse impact. A 1977 workshop on problems related to harassment of Hawaiian humpback whales concluded that vessel traffic not oriented toward whales would not ordinarily seem to disturb them. A 1977 review of the possible effects of noises emanating from offshore oil and gas developments concluded that, unlike the abrupt response to sudden disturbances, whales become habituated to low-level background noises such as would be associated with ship traffic. U.S. observers aboard foreign groundfish fishing vessels and U.S. scientists on scientific or commercial groundfish cruises have not reported the occurrence of any mortality or injury arising from contact between vessels or gear and any of these species.

Therefore, as long as the offshore fishery is restricted to the levels proposed in the FMP, it should have no adverse impact by harassment on these species of whales. The types of fishing gear used to catch herring are not expected to have any adverse impact upon these whales.

The potential impact of competition with herring fishing operations for the herring resource upon each whale species is addressed separately.

Gray whales are transients, passing through the Eastern Bering Sea in early summer and then again in late fall as they migrate to and from their preferred feeding grounds in the northern Bering and Chukchi Seas.

Probably 85-90% of the gray whale population passes within 3 miles of the coast in Togiak Bay. Their preferred food species are bottom dwelling amphipods. Consequently, competition for the resource with the herring fishery is unlikely to occur. However, the feeding habits of gray whales in the Bristol Bay region are unknown. It is possible, although unlikely, that they may consume some herring in the Togiak Bay region where many gray whales occur in the early summer.

Bowhead whales are associated with sea ice, and their preferred food items include euphausiids, copepods, and amphipods. They do not eat herring, and therefore, competition with the fishery is unlikely to occur.

Historically, the Eastern Bering Sea and the Aleutian Islands area form part of the summer feeding range of the right whale. This species is now extremely rare, but it feeds almost exclusively upon copepods. Competition with the herring fishery is thus unlikely.

Sperm whales are primarily associated with the continental slope and offshore. They are most numerous along the Aleutian Islands but occur occasionally in the Bering Sea. They feed there from May through September, upon squid, their preferred diet item. They also occasionally take deep water species of fish, including lancetfish, boarfish, and rockfish in the genus Sebastodes. Competition with the herring fishery is unlikely.

Fin and humpback whales use the Eastern Bering Sea and Aleutian Islands areas as feeding grounds from May through September. Both species feed primarily on euphausiids and pelagic schooling fish such as herring, capelin, and saury. Humpback whales take a greater percent of herring in their diet than do fin whales. The potential for competition with the fishery does exist. Under the circumstance, adverse impacts would result from an expanded fishery above levels proposed in the FMP, but should not exist at those levels. See Annex A. Historic levels of the herring fishery, as during the 1960's, might result in an adverse impact.

VII. PUBLIC COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND FISHERY MANAGEMENT PLAN

During the public comment period (November 11, 1979 to March 15, 1980) on the Draft Environmental Impact Statement, 24 written comments were sent in to the Council, and numerous individuals testified at the 8 public hearings held in Nome, Kotzebue, Unalakleet, Hooper Bay, Dillingham, Kodiak, Anchorage and Bethel.

Section I of this Chapter summarizes the comments made by members of the public and government agencies. After each comment the name (or names) of those originating the comment is stated and a response is made to each comment.

The listing of the locations and dates of public hearings is contained in Section II of this Chapter. Section III includes the listing of those presenting written comments, including state and federal government agency comments.

Section I. Response to Comments

A. Subsistence

1. Comments: The subsistence fishery is a vital part of the diet and culture of residents of the Nelson Island area and of less importance to residents of the Norton Sound/Kotzebue Sound region. The subsis-

tence fishery should be protected from the effects of the commercial fisheries.

Source: Individual fishermen in Kotzebue, Nome, Unalakleet, Dillingham, Bethel and Toksook Bay; Nunam Kitlutsisti; Rural Alaska Community Action Program; Marine Resources Company

Response: The subsistence fishery is acknowledged in the plan as having priority over directed offshore herring fisheries. Although the Council does not have direct management authority over the subsistence harvest, it is concerned that offshore management measures not adversely impact the subsistence harvest. Protective management measures included in the FMP include in-season stock estimations and in-season management changes if necessary, a controlled conservative offshore apportionment, sharp limitation on the incidental catch of herring by groundfish trawl fisheries, and provisions for area closures under certain circumstances.

2. Comment: An offshore commercial fishery for herring on their feeding grounds north of the Pribilofs could overfish a non-randomly distributed local stock due to the unknown degree of stock intermixing. This would have a serious effect on the local subsistence lifestyle. There should be no offshore fishery until distribution data are available.

Source: Rural Alaska Community Action Program; Alaska Board of Fisheries

Response: The degree of mixing of the different stocks in the winter feeding grounds is unknown. Available data cited in the FMP and EIS indicate, however, that this fear is unfounded, since discrete spawning stocks multiplied greatly during years in which offshore harvests were far greater than those possible under the FMP. Until more data become available to determine the exact degree of mixing, the Council has proposed a conservative offshore harvest strategy, a Herring Savings Area to protect wintering stocks and a reduction of OY to address subsistence concerns.

3. Comment: The subsistence harvest will not be adequately protected by excluding the biomass estimates of the stocks which support primarily a subsistence harvest from the amount available to be allocated to the commercial fisheries.

Source: Rural Alaska Community Action Program

Response: The Nelson Island stocks support a subsistence harvest only, and, thus, it was considered necessary to include management measures to reduce the total yield figure for socioeconomic reasons. The variable exploitation rates for different stocks that were used in the draft FMP to calculate ABC were revised to reflect a fixed exploitation rate for all stocks except Nelson Island stocks. A specific subsistence adjustment (500 mt) reducing OY further is also made.

4. Comment: Subsistence fisheries should not have the first priority; most subsistence fishermen are now commercial fishermen and local protection is not in the interest of all Alaskans.

Source: Commercial fisherman, Anchorage

Response: Alaska State law gives priority status to subsistence fishermen. While not bound by that law, the Council has incorporated its intent into the FMP.

5. Comment: No data exist to demonstrate the adverse impact on the subsistence fishery which might result from the operation of an offshore herring fishery.

Source: Marine Resources Company

Response: Sound conservation practice requires conservative management of offshore fisheries until it is shown that their expansion will not adversely affect inshore fisheries.

B. Domestic Inshore and Offshore Fisheries Priorities

1. Comment: The inshore roe fishery should not be ranked above the offshore food and bait fishery. The latter should be encouraged because it is less wasteful, potentially greater value and causes less adverse impact on the stocks through fishing. Such a distinction is also potentially discriminatory.

   Source: Marine Mammal Section, ADF&G; Marine Resources Company

   Response: The inshore fishery was given higher priority because of the present emphasis of management on discrete stocks, the sequential nature of the fishery and current economic importance of the inshore fishery. The plan also has an objective to encourage the development of inshore fisheries in western Alaska.

C. Goals and Objectives

1. Comment: The stated goals of the plan should include one which would refer to the need to rebuild the herring stocks to their former level of abundance.

   Source: Individual environmentalist; Friends of the Earth; Regional Office, Department of Interior; Nunam Kitlutsisti

   Response: The goal of rebuilding the herring stocks to the former level of abundance was included in the March, 1979 draft of the Herring FMP. It was not included as a goal in the later drafts of the FMP because former levels of resource abundance cannot be measured accurately. Herring abundance has increased and stabilized, although it remains below estimated MSY levels.

2. Comment: One of the goals of the FMP should include the recognition of herring as an important forage fish for many fishes, birds and mammals in the Bering/Chukchi Seas.

Sour _: Individual fishermen in Kotzebue, Unalakleet; Friends of the Earth; Rural Alaska Community Action Program; Regional Office, National Wildlife Federation; mammal biologist, ADF&G

Response: In the revised section on goals, the importance of herring as food fish is acknowledged by the statement that offshore herring harvest should insure "maintenance of the herring resource at a level that will sustain populations of predatory fish, birds and mammals."

3. Comment: A conservative management strategy for the herring fishery should be implemented until better information is available.

Source: Bristol Bay Native Association; Alaska Sea Grant Program; Regional Office, Department of Interior; Bering Sea Fishermen's Association

Response: This was the concern of most of the residents of Western Alaska referring to the expansion of the commercial fishery. A conservative management policy is not a goal, but rather a means of carrying out a goal. The proposed management strategy of the plan is to manage the herring stocks conservatively.

D. Maximum Sustainable Yield

1. Comment: The calculation of MSY on the basis of average annual catch from the years 1962 to 1976 is not a realistic estimate of what the ecosystem can sustain, because it includes those years when catches were so high that they resulted in the collapse of the stocks.

Source: Individual environmentalists; Friends of the Earth; Rural Community Action Program

Response: Given the lack of definitive biomass data, it is reasonable to use the long-term average catch of the foreign fishery from 1962 to 1976 as an estimate of MSY. An average must necessarily include the highest and the lowest catch estimate. This method may be revised as further offshore biomass information becomes available.

2. Comment: The calculation of MSY, based on the average annual foreign catch, is overly conservative based on the probability that the foreign catches are underlogged.

Source: Marine Resources Company

Response: The possibility of underlogging is acknowledged in the plan; however, there is no good estimate of the degree of underlogging. The average annual catch figure cannot be modified quantitatively to account for this problem. The management strategy is conservative because of the lack of total biomass data.

E. Acceptable Biological Catch

1. Comment: The methodology used to determine the spawning biomass of herring gives the impression of data manipulation in order to yield a conservative spawning biomass estimation.

Source: Public comments, Anchorage; Department of Interior; Representative of Japanese trawlers, Natural Resources Consultants, Marine Resources Company

Response: The methodology used to determine spawning biomass has been developed by ADF&G fisheries biologists, funded in part by the Council. The methodology itself is being perfected each year as logistical operations improve and as more information becomes available. The exact procedure is not described in the FMP because of the probability of modification and improvement each year. However, it will be reviewed by the Council each year at the time of determination of available yield. A conservative bias is acceptable to the Council when the best available data are incomplete and the methodology imperfect. Specific comments on the methodology used in the 1979 to 1980 season can be found in the Scientific and Statistical Committee Minutes of the Council.

2. Comment: The spawning biomass estimates are too low.

Source: Representatives of the Japanese trawlers; Natural Resource Consultants

Response: The decision to pick the low end of the range of estimates that occur in the calculation of spawning biomass was made because of the uncertainty of the data and methodology. This results in a conservative final estimate.

3. Comment: The exploitation rate used in the determination of acceptable biological catch should not be greater than 10%.

Source: Bering Sea Fishermen's Association; Nunam Kitlutsisti

Response: The exploitation rate is calculated by multiplying a base exploitation rate of 20% by the ratio of current biomass to the biomass that would produce MSY if exploited at a rate of 20%. Thus, if the spawning biomass is less than the spawning biomass estimate which would produce MSY, the exploitation rate would also be less. If the exploitation rate was fixed at 10%, there would be no means of increasing the amount available to be harvested by the fisheries during the years of high stock abundance, when the available data indicates that an exploitation rate approaching 20% would adequately conserve herring resources.

F. Optimum Yield - Total Allowable Catch

1. Comment: The OY should be low until better information is available.

Source: Public Testimony, Nome, Anchorage; Department of Interior

Response: The optimum yield is calculated at a level at which the stock can be harvested without risking the possibility of overfishing. The optimum yield estimates are low because of the uncertainties in the best available data and because of the undetermined impacts that

large expansion of effort by the offshore herring fishery might have. To calculate a more conservative OY would have resulted in underharvest and overprotection of stocks.

2. Comment: Optimum yield estimates are too low.

Source: Representatives of the Japanese Longline and Gill Net Association

Response: The optimum yield estimates are low because of uncertainties in the best available data and the short time period that the inshore roe fisheries have been operating. There is also relatively sparse data on the impact of fisheries offshore on the inshore fisheries and spawning stocks. The conservative use of the numbers and ranges obtained in the methodologies for MSY, ABC and OY were recommended by the Council in order to allow for a small offshore fishery while protecting the stocks until better data were available.

G. Allocation of Total Allowable Catch

1. Comment: Inshore and offshore domestic fishermen should have equal priority.

Source: Marine Resources Company

Response: The priorities of allocation were considered necessary because of the nature of the fisheries and migratory habits of herring. Over the year, herring are subject to several different types of fisheries, and the priority of allocation must be determined to ensure the annual OY is shared among the different fisheries. The priority given to inshore fisheries is based upon their ability to target readily on discrete herring stocks.

2. Comment: Partial allocation to TALFF is wrong.

Source: Representatives of Japan Deep Sea Trawlers Association; Representatives of Pacific Longline - Gill Net Association

Response: The FMP has been revised to eliminate apportionment to TALFF since it is clear that domestic and joint venture processors will be able to process the entire harvest.

3. Comment: How can the incidental catch be minimized?

Source: Representatives of Japan Deep Sea Trawlers Association; Rural Alaska Community Action Program; National Marine Fisheries Service

Response: Incidental catch of herring in the offshore fisheries will be controlled by the establishment of an allowable incidental catch (AIC) for U.S. vessels and a Prohibited Species Catch (PSC) for foreign vessels in the FMP. Once a nation exceeds its PSC or AIC, that nation will be prohibited from further trawling in all or part of the Herring Savings Area for the rest of the herring fishing year. An incentive to avoid concentrations of herring is achieved since nations will not want to jeopardize the harvest of their groundfish allocations.

4. Comment: The TALFF allocation is confusing and unscientific.

Source: Natural Resources Consultants

Response: See item G-2.

5. Comment: There should be no significant offshore trawl fishery.

Source: Alaska Department of Fish and Game; Nunam Kitlutsisti; Rural Alaska Community Action Program

Response: National Standard #1, Section 301 of the Magnuson Act requires that conservation and management measures be designed to permit achievement of OY. Available data indicates that it is not necessary for the protection of herring stocks to depress OY to levels precluding offshore fisheries on herring, even taking into account their relative nonselectivity. However, the high priority assigned to

inshore fisheries in the allocation procedure and the very conservative procedures for calculating the winter offshore apportionment of OY, place severe limits on offshore herring harvests. The incidental offshore harvest will be controlled by the establishment of AIC and PSC and implementation of a Herring Savings Area.

6. Comment: The partial allocation of TALFF is right.

   Source: Alaska Department of Fish and Game

   Response: This was addressed in item G-2.

7. Comment: DAH should equal OY.

   Source: Nunam Kitlutsisti

   Response: Under the revised FMP, DAH is equal to OY.

8. Comment: There may be both biological and economic reasons to prefer having as much of the herring TAC as possible be taken by gillnetting.

   Source: Pacific Longline - Gill Net Association

   Response: Any gill net fishery would occur within the three mile state jurisdiction, and gear restrictions within this area are the responsibility of ADF&G and not addressed by the FMP. However, it is recognized that fisheries (such as the gill net fishery) which harvest discrete stocks allow better management and protection of depressed stocks.

H. Time/Area Closure

1. Comment: What areas will be open to foreign fishing?

   Source: Public Testimony in Unalakleet, Dillingham

Response: Under the revised FMP, there will be no directed foreign herring fishery.

2. Comment: Time and area closures should be adequate to protect herring stocks.

Source: Dillingham public hearing testimony

Response: The entire FCZ is closed to herring fishing during the sac-roe fishery, all waters will remain closed until October 1 north of 56°47'N latitude, and all or part of the Herring Savings Area will be closed to nations with no PSC (or directed apportionment and AIC in the case of domestic fishermen) remaining.

3. Comment: Information on stocks throughout the Chukchi Sea must be obtained before sound management practices can be applied.

Source: Nana Development Corporation

Response: ADF&G began a research effort in the Kotzebue area in July 1980 and will continue it at least through the 1981 sac roe fishery. The effort will include aerial surveys and test net fishing. The objective is to determine the temporal and spatial distribution of herring. The Magnuson Act requires that conservation and management measures be based upon the best scientific information available, and does not require that fishing be suspended until the best possible evidence is obtained.

4. Comment: There are unnecessary regulations in the plan.

Source: Representatives of the Japan Deep Sea Trawlers Association

Response: The Herring Savings Area would be implemented only when PSC is achieved, thus eliminating the unnecessary regulation.

5. Comment: It is important to have a Herring Savings Area.

Source: Nunam Kitlutsisti; Rural Alaska Community Action Program; Bering Sea Fishermen's Association

Response: Area C, which was the largest of the Herring Savings Areas reviewed by the Council, was adopted. The Council considered it unnecessary and undesirable, however, to close Area C before a nation had exceeded its allowed incidental harvest (PSC or AIC).

6. Comment: Longliners should be exempted from the Herring Savings Area.

Source: Representatives of the North Pacific Longline - Gill Net Association

Response: Longline fishermen have been exempted from the Herring Savings Area because herring are not caught on longline gear.

7. Comment: The Herring Savings Area will have an impact on protection of marine mammals.

Source: Alaska Department of Fish and Game

Response: Any benefit to the herring resource will also benefit marine mammals feeding on that resource. Also, because fishing will be eliminated from the Herring Savings Area, harassment of marine mammals should also decrease in that area.

8. Comment: The Herring Savings Area will impact the foreign fishery for groundfish.

Source: National Marine Fishery Service

Response: The Regional Director has the option of closing only that portion of the Herring Savings Area necessary to protect the herring populations. This has the potential to reduce the impact on the foreign fishery, and the domestic fishery as well.

I. Enforcement - Observers

1. Comment: The observer program for the offshore fishery should be expanded because of the uncertainty of the validity of the foreign catch reports and of the need to have timely information for an in-season management strategy.

Source: Kawerack; Nunam Kitlutsisti

Response: The importance of adequate observer coverage to any fishery management plan cannot be stressed enough. Two proposed options linked the closing of the Herring Savings Area to a certain level of observer coverage of the foreign fishing fleet. Observer coverage in this area is important because the herring are concentrated and particularly vulnerable to the foreign fishing fleet. The new observer coverage requirements of the Magnuson Act should alleviate previous concerns about adequate observer coverage.

J. Research

1. Comment: No action or decisions should take place on the FMP until more information is available.

Source: Individual fishermen, Unalakleet, Nome; Regional Office, Department of Interior; Regional Office, National Wildlife Federation

Response: No action would imply no FMP. With the potential development of the domestic offshore fishery, the risk of adversely affecting the inshore fishery through an uncontrolled offshore fishery increases. The development of the FMP has resulted in several major research projects being instituted. One could conceivably support research projects until the end of the century and still not have all the answers to the questions. In the meantime, the Magnuson Act requires use of the "best scientific information available."

2. Comment: Research should be carried out to determine the importance of herring in the food chain.

Source: Individual fishermen, Kotzebue

Response: Recommendations are made in the plan for research programs to systematically investigate the degree of utilization of herring in the diet of marine mammals, salmon and other predators so that the ecological impacts of harvesting can be better evaluated.

3. Comment: Research should be carried out on the Chukchi Sea stocks of herring to determine their abundance and behavior.

Source: Nana Development Corporation

Response: Very little is known about the biomass or the behavior of the Chukchi Sea stocks. However, ADF&G began in 1980 to reconnoiter the spawning shcools in the Chukchi Sea during the late summer.

K. Herring and the Ecosystem

1. Comment: Herring is part of the ecosystem. The plan should consider the ecosystem and the impact of the herring fisheries on the ecosystem.

Source: Individual fishermen, Kotzebue; Friends of the Earth; Nunam Kitlutsisti; Regional Office, Department of Interior; individual environmentalist

Response: This general comment was raised by many people. The ecosystem of the Bering Sea, both within and outside of three miles offshore, is being studied under OCS and other research programs until the dynamics are determined. The best available scientific information on the effect of herring fishing on the ecosystem was used in developing the FMP. Far more information has yet to be gathered, however.

2. Comment: The goals and objectives of the plan should include the consideration of herring as a forage species for marine mammals.

   Source: Individual fishermen, Unalakleet; Kawerack; Friends of the Earth; Rural Alaska Community Action Program; mammal biologist, ADF&G

   Response: The goals and objectives section was changed to include the goal to maintain the herring resource at a level that will sustain populations of predatory fish, birds, and marine mammals. This is a long-term goal.

3. Comment: The forage needs of endangered species were not considered in the plan.

   Source: Friends of the Earth

   Response: Consultation with the Marine Mammal Laboratory in Seattle have shown that herring is a minor component of the diet of humpback whales, but that the fishing levels proposed in the FMP would not jeopardize these whales. No endangered birds feed on herring.

4. Comment: The herring fishery could potentially adversely impact the migratory birds that feed on herring.

   Source: Friends of the Earth; Regional Office, Department of the Interior

   Response: The calculation of natural mortality does account for the largest percentage of the stock taken by fish, birds, marine mammals, etc. It is unlikely that the offshore fishery, at proposed levels of catch, will result in adverse impacts to marine birds. Interruption of groundfish fisheries by overly restrictive measures to protect herring could affect some marine birds adversely by depriving them of a source of readily available food in the form of fishing wastes.

5. Comment: No reference is made to the roe on kelp fishery, or the potentially harmful effects of the fishery on the health of the kelp beds.

Source: Individual environmentalist; Friends of the Earth; Regional Office, Department of Interior

Response: The management plan for the roe on kelp fishery is available from ADF&G offices in Anchorage, Alaska. The recovery rates of kelp beds after being fished have been determined, and, thus, a measure of the potential impact exists. The management of this fishery is under the exclusive jurisdiction of the Alaska Board of Fisheries, and regulations under the FMP would not affect it.

6. Comment: The impacts of a herring fishery in Cape Newenham National Refuge and Clarence Rhodes National Wildlife Refuge have not been addressed.

Source: Regional Office, Department of Interior

Response: Under the D-2 legislation, Clarence Rhodes has been incorporated into the new Yukon Delta National Wildlife Refuge. The zone of ecological concern is within state waters and any problems arising will be worked out between the Interior Department and the State of Alaska.

7. Comment: The incidental catch of non-herring species could adversely impact the marine birds and mammals in the National Wildlife Refuge.

Source: Regional Office, Department of Interior

Response: Herring are a seasonal visitor to these wildlife refuges. Schools move rapidly in and out of bays. Herring would thus be an opportunistic food for local species with restricted feeding range. Large by-catches of their more stable food supply could have adverse impacts. The inshore fishery is under State of Alaska jurisdiction and is not governed by the FMP.

8. Comment: There is a potential for adverse environmental impacts by pollution from the growing number of fishing boats in the inshore area (chemical pollution, high noise levels, etc.).

Source: Regional Office, Department of Interior; Nunam Kitlutsisti

Response: Pollution control in the inshore area is the responsibility of the Alaska Departments of Environmental Conservation and Public Safety, and the Alaska Board of Fisheries. It will become more necessary as the fishery develops. The Council can only encourage the State agencies to address this problem.

9. Comment: The importance of environmental factors on the cyclical fluctuations in herring stocks has not been adequately addressed.

Source: Mammal biologist, ADF&G

Response: It is agreed that environmental conditions play a major role in the success or failure of recruitment. However, the factors causing the fluctuations in herring stocks have not yet been determined. The management strategy is conservative until these factors are better understood.

10. Comment: Inshore fisheries will adversely affect the inshore environment, including the spawning stocks of herring.

Source: Friends of the Earth; Regional Office, Department of Interior

Response: The inshore fisheries do have the potential for affecting the physical environment if the fishing effort is too concentrated in any particular area. This is a matter of orderly development of the fishery and control of effort on the grounds by the responsible agencies of the State of Alaska.

Section II. Public Hearings on Herring FMP and EIS

Nome	11/12/79
Kotzebue	11/12/79
Unalakleet	11/13/79
Dillingham	11/16/79
Kodiak	11/29/79
Anchorage	11/30/79
Bethel	2/9/80
Hooper Bay	3/5/80

Additional Public Hearings on the FMP

Anchorage	9/24-25/81
Anchorage	12/7-9/81
Bethel	11/9/82
Anchorage	12/7-9/82

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LIST OF GOVERNMENT AGENCIES, ORGANIZATIONS AND INDIVIDUALS FOR COMMENT

These included:

Federal Agencies

U.S. Corps of Engineers
Bureau of Land Management
National Park Service
U.S. Coast Guard
Environmental Protection Agency
Department of the Interior
Department of State
Department of Transportation
U.S. Fish and Wildlife Service

State Agencies

State of Alaska, Office of the Governor
Alaska Department of Fish and Game
Alaska Commercial Fisheries Entry Commission

Individuals and Organizations

Alaska Native Corporations
Conservation Organizations
Fishermen's Groups
Seafood Industry
Industry Associations
Libraries
Press
Universities

GLOSSARY OF ABBREVIATIONS

ABC	Allowable Biological Catch
ADF&G	Alaska Department of Fish and Game
AIC	Allowable Incidental Catch
Board	Alaska Board of Fisheries
BS/AI	Bering Sea/Aleutian Islands
Council	North Pacific Fishery Management Council, Anchorage
DAH	Domestic Annual Harvest
DAP	Domestic Annual Processing
DNP	Domestic Non-Processing
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973
FCZ	Fishery Conservation Zone
FMP	Fishery Management Plan
Groundfish FMP	FMP for Groundfish in the Bering Sea/Aleutian Islands Area
JVP	Joint Venture Processing
Magnuson Act	Magnuson Fishery Conservation and Management Act
MFCMA	Magnuson Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSY	Maximum Sustainable Yield
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OY	Optimum Yield
PMP	Preliminary Fishery Management Plan
PSC	Prohibited Species Catch
RD	Regional Director of NMFS, Alaska Region
TAC	Total Allowable Catch (no longer used; now OY)
TALFF	Total Allowable Level of Foreign Fishing